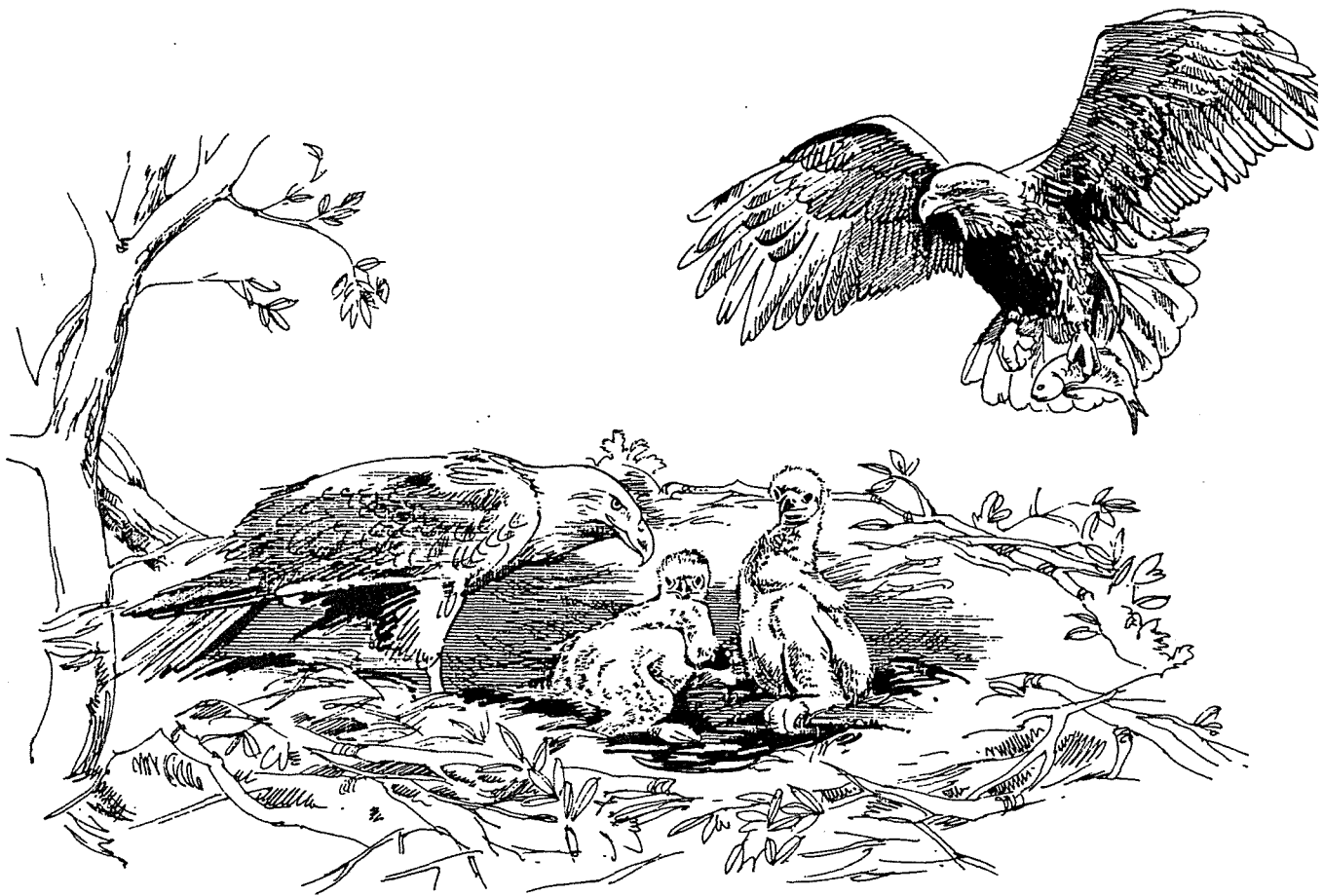


MONTANA BALD EAGLE NESTING HABITAT



A Macro-Habitat Description

Montana Bald Eagle Nesting Habitat
Macro-Habitat Description

BY

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MARCH 1986

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ACKNOWLEDGEMENTS

This survey would not have been possible without the coordination and support of the Montana Bald Eagle Working Group. Dennis Flath, Montana Department of Fish, Wildlife and Parks; Rob Hazlewood, Bureau of Land Management; and Lorin Hicks, Plum Creek Timber Company, were especially helpful in macro-habitat survey form design. The following individuals completed survey forms for their respective nest sites: Rob Hazlewood, Bureau of Land Management; Robin Magaddino, U.S. Fish and Wildlife Service; and Tom O'Neil, Montana Power Company. Special thanks to Steve Martinez, Helena National Forest, who completed survey forms for 27 nests and Renee Rumrill who, as a Forest Service volunteer, completed the survey for three nests and completed the random point data work up for Zone 018. Riley McClelland, University of Montana, was extremely helpful in the random point statistical design and coordinating volunteer help for this project. We are grateful for the many hours Bill Donnelly, Forest Service Regional Office, spent putting together the computer programs for this project. Thanks to all the biologists who opened up their files and furnished information for this project. We thank Rose Leach for her editorial comments.

ABSTRACT

An inter-agency effort coordinated by the Montana Bald Eagle Working Group surveyed 44 bald eagle nests on 37 territories in Montana during 1983 and 1984. Sixty-four macro-habitat variables were measured for each nest using aerial photos, topographic maps, and planimetric maps. Because of the limited sample of nests in eastern Montana only the data for 37 western Montana nests were analyzed. Macro-habitat descriptions are presented for 28 bald eagle nests in northwestern Montana and 9 nests in the Yellowstone area.

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I. INTRODUCTION

1

The Montana Bald Eagle Working Group identified bald eagle (Haliaeetus leucocephalus) nesting habitat analysis as one of the top priorities in Montana. A nest site description form was developed to standardize habitat survey efforts. This report is the result of an interagency effort to describe macro-habitat characteristics of nesting habitat in Montana. Macro-habitat surveys include information that can be gleaned from aerial photos, topographic maps, and planimetric maps (Noon, et. al., 1980). This type of information can be used to identify general nesting habitat characteristics that may be very useful in identifying or rating potential bald eagle nesting habitat (Grubb 1976; Leyman 1979).

A total of 98 nests on 71 territories has been identified in the state (MTBEWG, unpub.). Our original objective was to survey only those nests on or adjacent to National Forest lands (27 nests), but with the help of the Working Group we were able to increase our sample size to 44 nests representing 37 territories. Montana has been divided into 7 management zones (Figure 1). Virtually all of the nests surveyed are within 2 management zones: Upper Columbia (007), and Greater Yellowstone (018) (Table 1). Because of the limited sample sizes in the other 5 management zones, only the data for Zones 007 and 018 are presented in this report.

Table 1 Nest Site Description Form Status

	Management Zones							
	007	018	038	039	040	041	047	TOTAL
# Nests Known(1986)	57	13	6	6	8	7	1	98
# Nests Sites Identified	47	9	6	6	8	7	1	84
# Nests Sites Surveyed	28	9	1	2	0	4	0	44
Percent Complete	60%	100%	17%	33%	0%	57%	0%	51%

This report is a compilation of summary statistics for the quantifiable macro-habitat variables. We avoided interpretation of the statistics in relation to habitat quality and did not attempt to distinguish between habitat use as a function of availability or actual preference by bald eagles. Therefore, interpretations of habitat selection, habitat quality, or extrapolation to other management units should not be made from these data.

We are currently conducting a multivariate analysis of the data presented in this report. That analysis is useful to determine significant ecological variables in nest site selection, and to determine habitat availability and preference. That analysis will form the basis for a bald eagle nesting habitat suitability model.

BALD EAGLE MANAGEMENT AND RECOVERY ZONES IN MONTANA

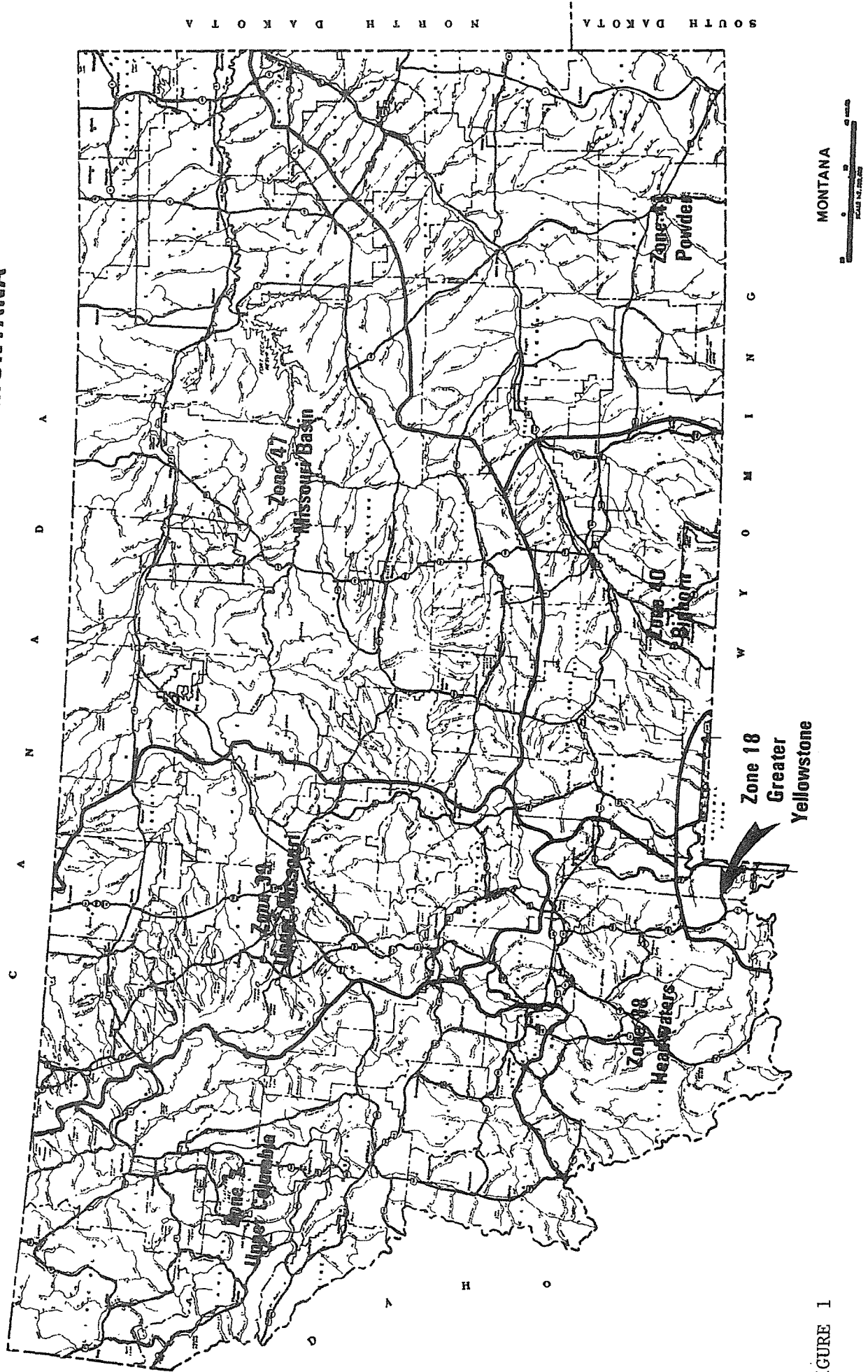


FIGURE 1

II. METHODS

To assure standard data collection with multiple surveyors, a Nest Site Description Form was developed (Appendix I). This form includes 64 macro-habitat variable sets classified into the following 6 groups: General (6 variables), Physical/Topography (16 variables), Habitat Composition (9 variables), Potential Disturbances (22 variables), Land Status (6 variables), and Territory Interspersion (5 variables). A description of each variable, the unit of measurement, and the source of extrapolation are defined on the instruction sheets included with the Nest Site Description Form (Appendix I). The list of variables is included as Appendix II.

A Nest Site Description Form was completed for 37 nest sites within management zones 007 and 018 during the winter 1983-1984. In territories with multiple nests we included the alternate nests if they had sufficiently different Nest Site Description Form results. The list of these nest sites and associated territories is included as Appendix III, and Table 1 shows the number of nest sites identified for each management zone. All of the information needed to complete the form was taken from aerial photos, U.S.G.S. topographic quad sheets, and planimetric National Forest maps. Stream order descriptions were based on standard hydrologic definitions (Chow, 1964). We arbitrarily selected 3 miles as the maximum distance for all measurements included on the form. The nest site description data was loaded into a Proxi data base on the Forest Service Data General computer in Missoula, Montana. This enabled us to sort and run general statistical analysis of the data base. All direction to variables were analyzed using techniques described by Batschelet (1981). Hypothesis testing and correlation analysis were completed using the DAISY statistical analysis package on an Apple IIe computer. Forty-six variables were analyzed in this manner; the other 18 variables were not quantifiable and were not included in this analysis (Appendix II).

In addition, 4 variables which were not included on the survey form were added to the analysis. Two are presented under the General category: nest tree species and average annual snowfall, and 2 are presented under Physical/Topography: distance to still water inlet or outlet, and distance to major tributary. The species of nest tree for each nest site was gleaned from the Nest Record Forms or personal communication with knowledgeable biologists. Average annual snowfall was taken from the 1958-1972 Average Annual Snowfall Map for Montana (USDA 1975). Snowfall is a measure of the amount of precipitation falling as snow, not the depth of snow on the ground, nor the amount of water equivalent precipitation. Lake/reservoir inlet, outlet, and associated water body tributary distances were measured to the nearest 1/4 mile on National Forest planimetric maps.

III. RESULTS

The macro-habitat descriptions for 28 nests within Management Zone 007 and 9 nests within Management Zone 018 are presented in this section in paired format to facilitate comparisons between these management zones. The variables are grouped into 6 descriptive categories and listed in the order found on the Nest Site Description Form. An analysis of variable correlations is included as a separate heading in this section. Because of missing values for for some variables, not all of the tables necessarily agree on sample size.

A. General

The 6 variables originally included in the general category are descriptive and were not included in the quantitative analysis. Only the 2 general variables added to the analysis are included in this section: average annual snowfall and nest tree species. The names and code numbers of the territories surveyed are listed in Appendix III.

1. Average Annual Snowfall

We added the snowfall data to the analysis to obtain a measure of the climatic severity at the nest sites. This variable is a function of precipitation and temperature, and could be a measure of the effective length of the nesting season. Snowfall data was mapped at 50 and 100 inch contour intervals and we present the data in this format (Table 2).

Even though the nest site elevations are quite different between Zones 007 and 018 the distribution of nests by snowfall are similar; both average about 100 inches average annual snowfall (Table 2). None of the bald eagle nests are found in areas with greater than 300 inches, and over 90 percent of the nests are found in areas below 200 inches average annual snowfall. The greatest percentage of nests in both zones are found in the 50-100 inch bracket.

Table 2 Average Annual Snowfall

Zone	< 50in.	50-100in.	100-200in.	200-300in.	>300in.
007	6 (17.6%)	18 (52.9%)	6 (17.6%)	4 (11.8%)	0 (0%)
018	0 (0%)	5 (62.5%)	3 (37.5%)	0 (0%)	0 (0%)

Zone	Mean	S.D.	N
007	100.0 in.	67.41 in.	34
018	103.13 in.	38.82 in.	9
Total	100.60 in.	62.59 in.	43

2. Nest Tree Species

We completed a frequency analysis of nest tree selection for both management zones. We classified nest trees into 4 categories: (1) live coniferous, (2) coniferous snags, (3) live deciduous, and (4) deciduous snags. Table 3 shows the distribution of nest trees for these 4 categories.

Table 3 Nest Tree Distribution

<u>Category</u>	<u>007</u>	<u>018</u>	<u>Total</u>
<u>Live Coniferous</u>	23 (51%)	6 (67%)	29 (54%)
<u>Coniferous Snags</u>	9 (20%)	1 (11%)	10 (18%)
<u>Live Deciduous</u>	5 (11%)	1 (11%)	6 (11%)
<u>Deciduous Snags</u>	8 (18%)	1 (11%)	9 (17%)

The nest tree category use is similar between the management zones, except a greater number of snags are used in Zone 007 (Table 3). Most of the nests in both zones are found in live conifers. The use of snags for both zones is evenly split between dead conifers and dead deciduous. All of the deciduous trees (dead or alive) used in western Montana are black cottonwood (Populus trichocarpa). No attempt was made to identify species of conifer snag used.

The major difference between the 2 zones is the species of conifer used (Table 4). Ponderosa pine (Pinus ponderosa) is the most frequent nest tree in Zone 007, while Douglas-fir (Psuedostuga menziesii) is the only live conifer used in Zone 018. Douglas-fir is the second most frequently used species of live conifer in Zone 007. These 2 species comprise over 75 percent of the live conifer nest trees in both zones, and almost half of the total number of nest trees used.

Table 4 Species of Live Conifer Nest Trees

<u>Species</u>	<u>007</u>	<u>018</u>	<u>Total</u>
<u>Ponderosa pine</u>	12 (52%)	0 (0%)	12 (41%)
<u>Douglas fir</u>	4 (17%)	6 (100%)	10 (35%)
<u>Larch</u>	3 (13%)	0 (0%)	3 (10%)
<u>Spruce</u>	2 (9%)	0 (0%)	2 (7%)
<u>Western white pine</u>	2 (9%)	0 (0%)	2 (7%)

B. Physical/Topography

In addition to the original 16 physical or topographic variables included on the Nest Site Description Form, distance to still water inlet or outlet and distance to major tributary are described in this section.

1. Elevation

The 2 management zones differ greatly in nest site elevation. The average Zone 018 nest site elevation is over 3000 feet higher than Zone 007 (Table 5). This reflects the difference in the range of elevations available in the 2 management zones. The lowest elevation available within Zone 018 is over 5000 feet. This is higher than the highest nest site within zone 007 (Figure 2). The nest sites are generally on the lower elevations of each zone. One-half of the nests are below 3650 feet (Zone 007) and 6500 feet (Zone 018) (Table 5).

Table 5 Nest Site Elevation

Zone	Mean	S.D.	Min.	50%	75%	90%	Max.
007	3510 ft.	764 ft.	2100 ft.	<3650 ft.	<4040 ft.	<4300 ft.	4920 ft.
018	6561 ft.	368 ft.	5760 ft.	<6500 ft.	<6800 ft.	<6880 ft.	6960 ft.

2. Aspect

The nest site aspect is generally northerly for both management zones (Figure 3). The lack of southerly aspect nest sites, especially in management zone 007, is striking. The mean vector length (r) is a relative measure of concentration, and is measured on a scale from 0 (essentially random) to 1.0 (all points in the same direction). Angular variation (A.V.) is a measure of dispersion of data points about the mean, similar to standard deviation in linear statistics. The 007 nest sites exhibit a tighter grouping ($r = .72$, A.V. = 43 degrees) than the 018 nest sites ($r = .54$, A.V. = 55 degrees).

3. Slope

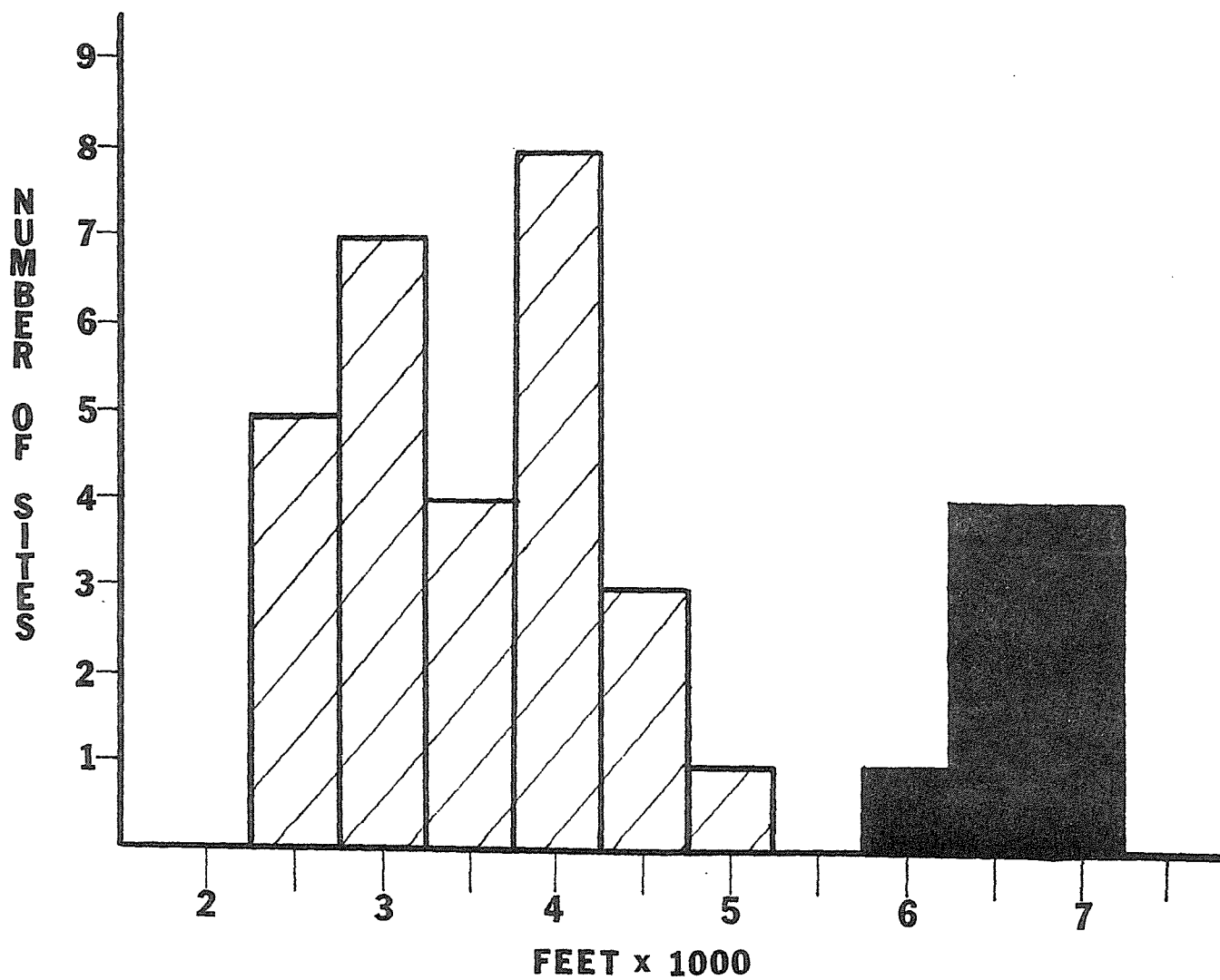
The percent slope of the nest site is very different between the 2 management zones (Figure 4). The nest site slopes average almost 30 percent steeper in Zone 018 (Table 6). Virtually all (90%) of the Zone 007 nest sites are on less than 40 percent slopes, and 3/4 of the nests in this zone are on less than 20 percent slopes. All of nests in both zones are on less than 65 percent slopes.

Table 6 Percent Slope

Zone	Mean	S.D.	Min.	50%	75%	90%	Max.
007	15 %	16 %	0 %	<8%	<20%	<40%	50%
018	42 %	15 %	24 %	<39%	<56%	<60%	64 %

Figure 2.

Elevation of Nest Sites Distribution

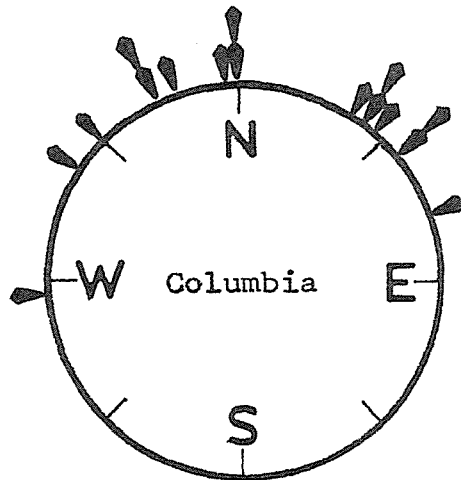


007



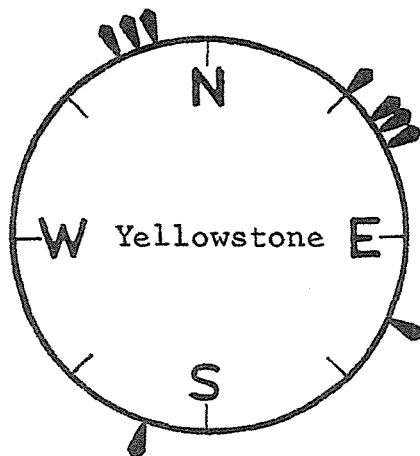
018

Figure 3. Aspect of the Slope



$$\begin{aligned}\bar{x} &= 6^{\circ} \\ r &= .72 \\ \text{A.V.} &= 43^{\circ}\end{aligned}$$

\bar{x} = mean direction
 r = mean vector length
 A.V. = angular variation



$$\begin{aligned}\bar{x} &= 39^{\circ} \\ r &= .54 \\ \text{A.V.} &= 55^{\circ}\end{aligned}$$

4. Position on slope

Most of the nest sites are located below the mid-slope in both management zones (Figure 5). The use of lower slope positions is strongest in Zone 007 where 75 percent of the nest sites are on the lower 1/3 of the slope, or below. None of the Management Zone 018 nest sites are located on flat ground (valley floor), while 50 percent of the nest sites in Zone 007 are on flat ground (Figure 5).

5. Type of Associated Water Body

Sixty-eight percent of the nests in both zones are associated with still bodies of water; e.g., lakes, reservoirs, ponds, and marshes (Table 7). The split between still and running (rivers) associated water bodies is different between the 2 management zones. Over 1/3 of the nests in Management Zone 007 are associated with rivers, while only 11 percent of the nests in Zone 018 are associated with rivers. Natural lakes are used most often by nesting bald eagles in both zones.

Table 7 Type of Associated Water Body

Zone	Lake	Reservoir	River	Other
007	16 (57%)	1 (4%)	11 (39%)	0
018	5 (56%)	2 (22%)	1 (11%)	1 (11%)
TOTAL	21 (57%)	3 (8%)	12 (32%)	1 (3%)

6. Size of Associated Still Water Body

All of the associated running water bodies in both zones are rivers (greater than fourth order stream class). The associated still water bodies range from 41 to 126,000 surface acres in size (Table 8). The use of still water bodies is similar between the 2 management zones: the median water body size is approximately 1000 surface acres; the minimum size used is approximately 50 surface acres; and virtually all the nests (90%) are associated with still water bodies greater than approximately 200 surface acres.

Table 8 Size of Associated Still Water Bodies (acres)

Zone	Median	Min.	50%	75%	90%	Max.
007	1110	60	>1357	>352	>150	126,000
018	980	41	>679	>283	>211	12,500

Figure 4. Slope Distribution

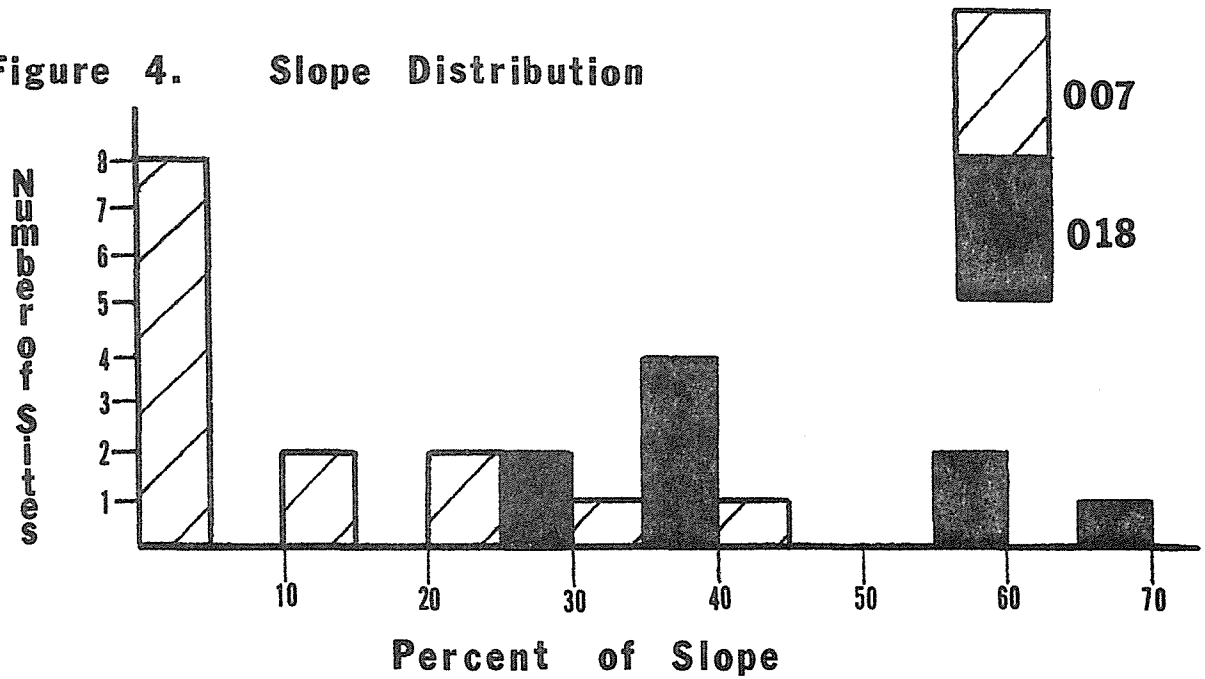
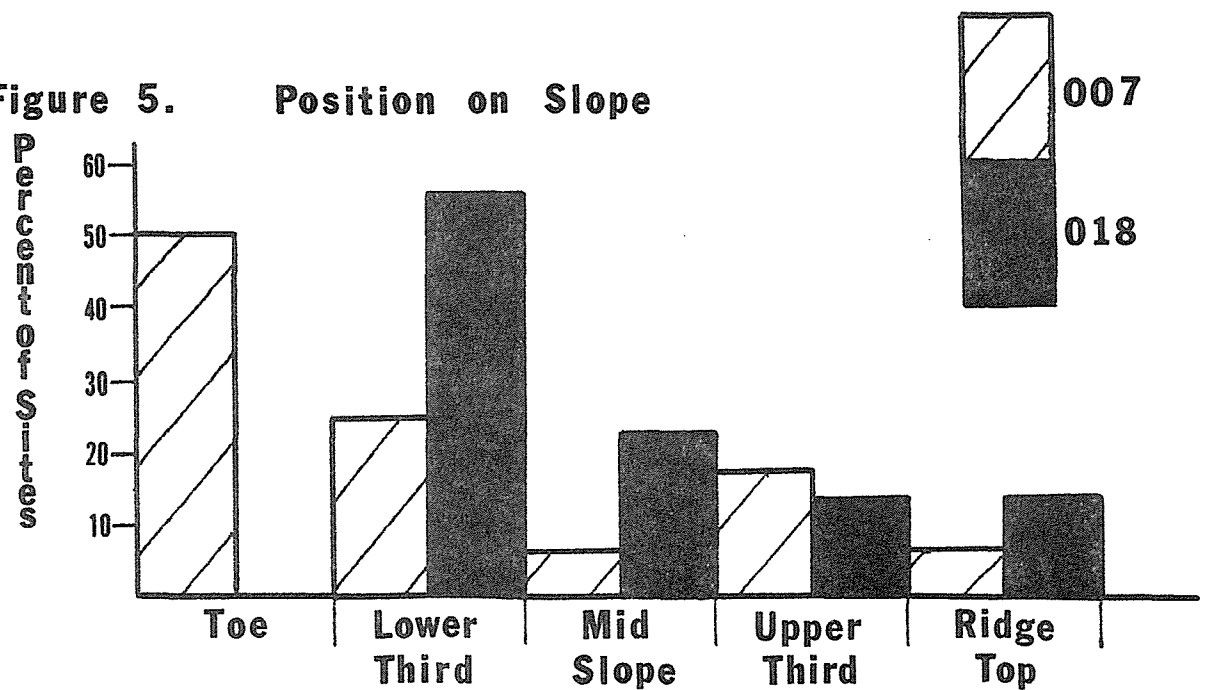


Figure 5. Position on Slope



7. Direction to Associated Water Body

There is no apparent pattern of the orientation of the nest site to the associated water body in either management zone (Figure 6). The summary statistics are similar for both zones: low mean vector lengths (r) and high angular variation (A.V.) (Figure 6).

8. Distance to Associated Water Body

The distance between bald eagle nest sites and the associated water body is very similar for both management zones (Table 9). There appears to be a strong tendency for bald eagles to nest close to water. All of the nest sites in both zones are located within 1 mile of their associated water body, and 75 percent of the nests are less than 1/4-mile from the water body.

Table 9 Distance to Associated Water Body

Zones	Mean	S.D.	Min.	50%	75%	90%	Max.
007	983 ft.	1096 ft.	1 ft.	<530 ft.	<1320 ft.	<2006 ft.	5280 ft.
018	1164 ft.	1605 ft.	75 ft.	<500 ft.	<1056 ft.	<1373 ft.	5280 ft.
TOTAL	1027 ft.	1216 ft.	1 ft.	<1000 ft.	<1500 ft.	<2000 ft.	5280 ft.

9. Elevation Above Water

The strong tendency to nest near the associated water body is verified by low nest site elevation above the water body (Figure 7). All of the nest sites in both zones are less than 600 feet elevation above the associated water body (Table 10). Virtually all the nest sites (90%) are less than 200 feet (Zone 007) and 300 feet (Zone 018) above the water body. Nest sites within Zone 018 average about 100 feet higher than in Zone 007.

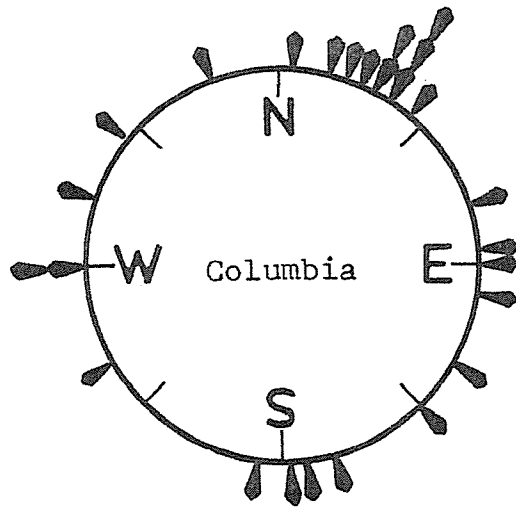
Table 10 Elevation Above Associated Water Body

Zone	Mean	S.D.	Min.	50%	75%	90%	Max.
007	73 ft.	104 ft.	4 ft.	<40 ft.	<65 ft.	<180 ft.	457 ft.
018	187 ft.	167 ft.	50 ft.	<100 ft.	<265 ft.	<285 ft.	567 ft.

10. Line-of-Sight to Associated Water Body

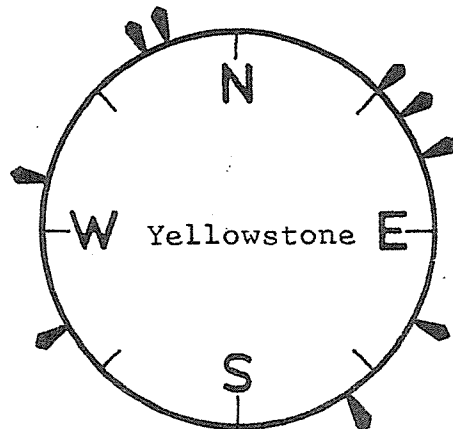
All of the nest sites in both management zones are within topographic line-of-sight of the associated water bodies. This is the only variable measured that did not show any variation. This appears to be an important component of suitable bald eagle nest sites.

Figure 6. Direction to Associated Water Body



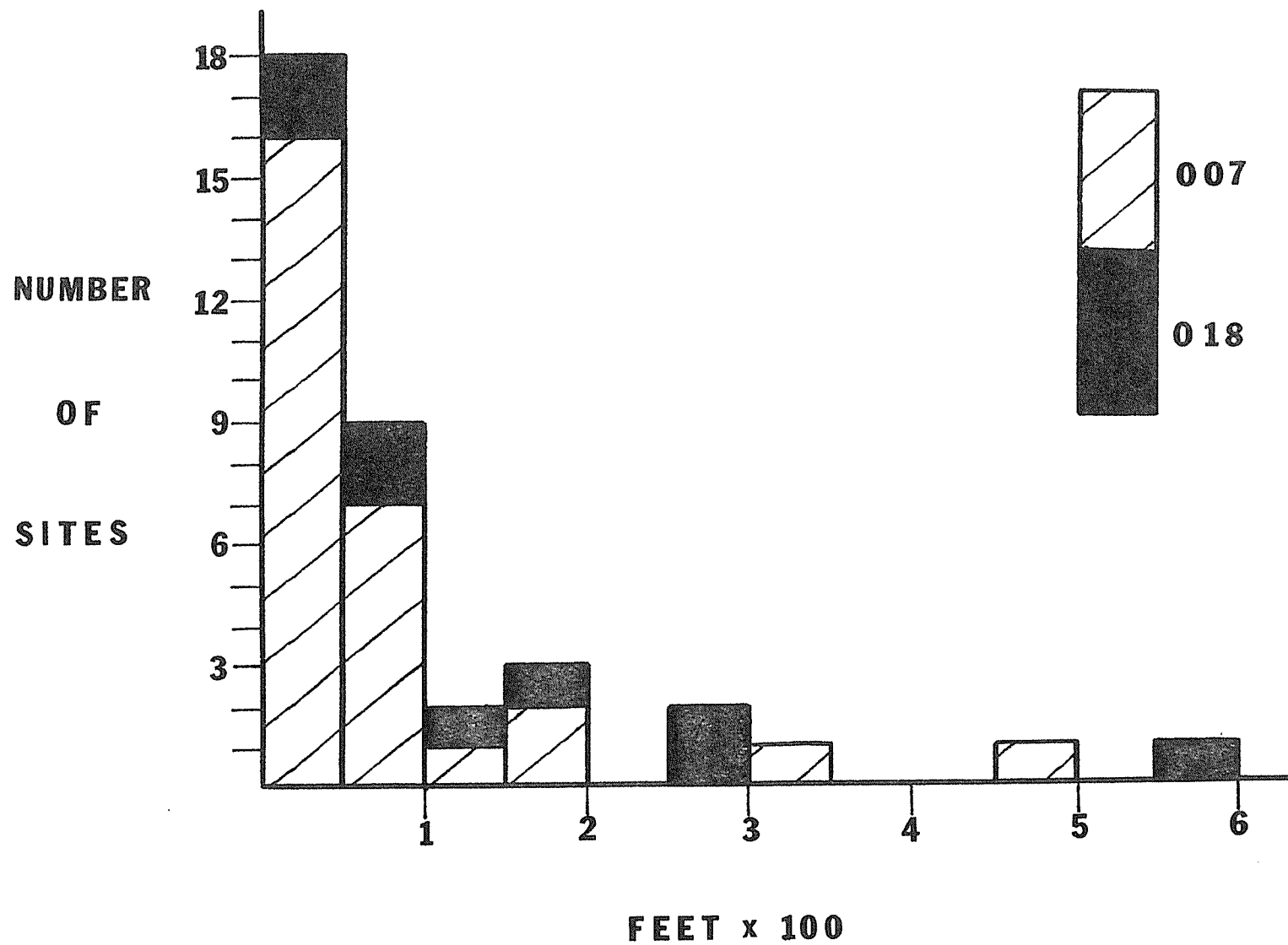
$\bar{x} = 48^\circ$
 $r = .29$
 $A.V. = 68^\circ$

\bar{x} = mean direction
 r = mean vector length
 $A.V.$ = angular variation



$\bar{x} = 32^\circ$
 $r = .27$
 $A.V. = 55^\circ$

Figure 7. Elevation above AWB Distribution



11. Direction to Greater Than Fourth Order Stream

The direction from the nest site to the nearest major stream course (greater than fourth order stream class) shows no distinctive pattern (Figure 8). The average direction is northeasterly for both management zones, but the grouping is not particularly tight ($r = .31, .51$) and the angular variation is high.

12. Distance to Greater Than Fourth Order Stream

The average distance to major streams (greater than fourth order stream class) is different between the 2 management zones. The nest sites in the 007 zone average almost a mile closer to major streams than those in Zone 018 (Table 11).

Table 11 Distance to Major Stream

Zone	Mean	S.D.	Min.	Max.
007	1.64 mi.	1.36 mi.	0.1 mi.	3.0 mi.
018	2.58 mi.	0.98 mi.	0.1 mi.	3.0 mi.

13. Greater Than Fourth Order Stream Miles Within a Three Mile Radius

Table 12 shows the miles of major streams (greater than fourth order stream class) within a 3 mile radius of the nest site. The stream miles within Zone 018 had few major stream miles, so the data is lumped for both zones into 2 categories: all nests (ALL) and only those nests that actually had major streams within 3 miles (RIVER). Less than 1/2 of the eagle nests in the 2 management zones have major streams within a 3 mile radius of the nest. Ninety percent of the nests that are associated with major streams have greater than 3 major stream miles within a 3 mile radius of the nest.

Table 12 Major Stream Miles

	Mean	S.D.	Min.	50%	75%	90%	Max.
ALL	4.1 mi.	5.5 mi.	0 mi.	0 mi.	<7 mi.	<10 mi.	20 mi.
RIVER	8.9 mi.	4.8 mi.	3 mi.	>8 mi.	>4 mi.	>3 mi.	20 mi.

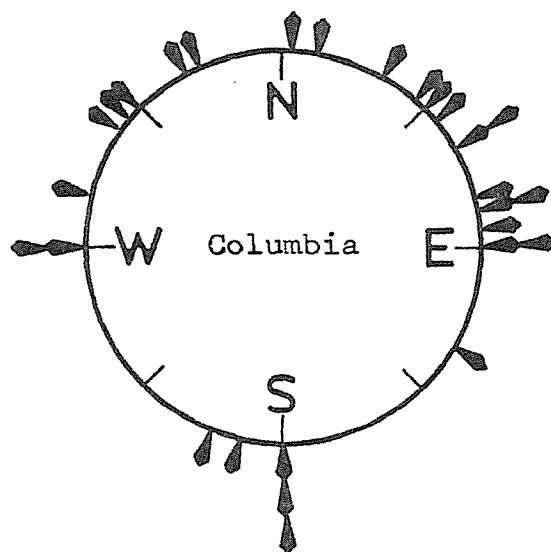
14. Direction to Still Water

We measured the direction to the nearest 50 acre (or larger) lake or reservoir, and no distinctive pattern is evident (Figure 9). The average direction to the nearest still water is northeasterly in both management zones, but the grouping is not tight ($r = .11, .31$) and the angular variation is high.

15. Distance to Still water

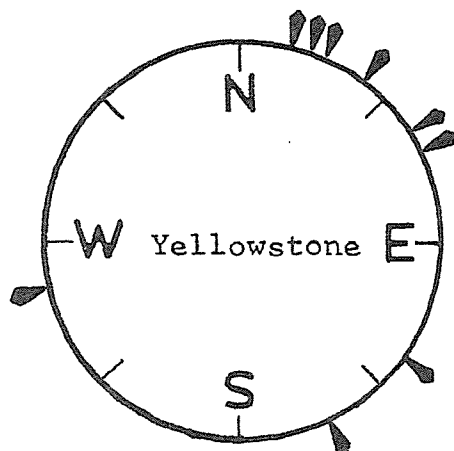
Distances from the nest site to reservoirs, ponds, lakes, etc. follow similar patterns in both management zones (Table 13). Virtually all (90%) of the nest sites are within 2.5 miles of still water greater than 50 acres (Figure 10).

Figure 8. Direction to 4th Order Stream



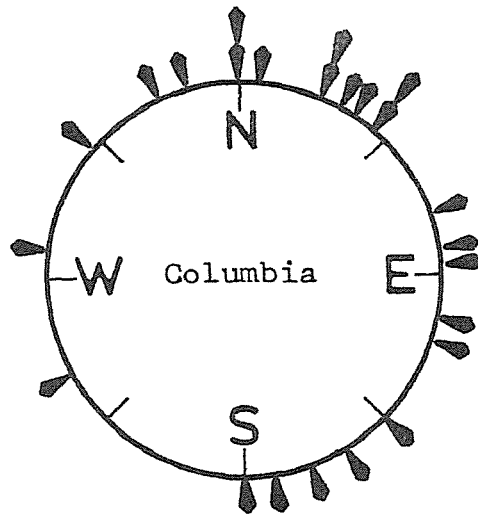
$\bar{x} = 40^\circ$
 $r = .31$
 A.V. = 67°

\bar{x} = mean direction
 r = mean vector length
 A.V. = angular variation



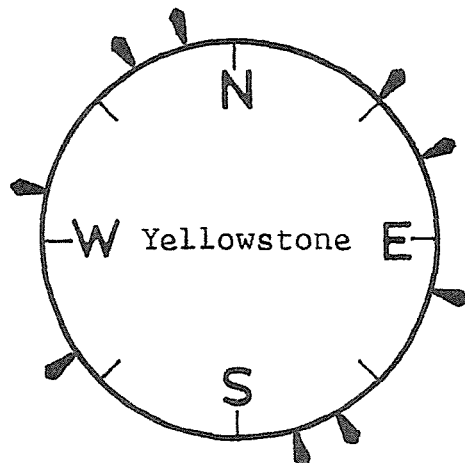
$\bar{x} = 53^\circ$
 $r = .51$
 A.V. = 57°

Figure 9. Direction to Still Water



$\bar{x} = 50$
 $r = .31$
 A.V. = 67

\bar{x} = mean direction
 r = mean vector length
 A.V. = angular variation



$\bar{x} = 56$
 $r = .11$
 A.V. = 77

Table 13 Distance to Still Water

Zone	Mean	S.D.	Min.	Max.
007	0.81 mi.	1.02 mi.	0.1 mi.	3.0 mi.
018	0.83 mi.	1.13 mi.	0.1 mi.	3.0 mi.

16. Shoreline Miles within Three Mile Radius

Nest sites within Management Zone 018 average more still water shoreline miles within a 3 mile radius of the nest than nest sites within Zone 007 (Table 14). Ninety percent of the nest sites in Zone 018 have greater than 6 miles of shoreline within a 3 mile radius of the nest, while only 50 percent of the Zone 007 nest sites have greater than 6 miles of shoreline within the same distance from the nest. Zone 018 has more shoreline because a higher percentage of its nests are associated with still bodies of water.

Table 14 Shoreline Miles

Zone	Mean	S.D.	Min.	50%	75%	90%	Max.
007	7.1 mi.	5.8 mi.	0.0 mi.	>6 mi.	>2 mi.	>0 mi.	26 mi.
018	10.1 mi.	6.1 mi.	0.0 mi.	>6 mi.	>7 mi.	>6 mi.	22 mi.

17. Distance to Still Water Inlet or Outlet

The still water nest sites in both management zones are more closely associated with the major inlet to the lake or reservoir, than the outlet to the water body (Table 15).

Table 15 Distance to Still Water Body Inlet or Outlet

Zone		Mean	S.D.	Min.	Max.
007	INLET	4.16 mi.	6.27 mi.	.25 mi.	20 mi.
	OUTLET	6.38 mi.	6.43 mi.	.50 mi.	27 mi.
018	INLET	1.50 mi.	1.46 mi.	.50 mi.	4 mi.
	OUTLET	6.63 mi.	5.15 mi.	1.5 mi.	12 mi.

18. Distance to Major Tributary

Nest sites in both zones are located near a major tributary (greater than second order stream class) of the associated water body (Table 16). The average distance to a major tributary is about 1 mile for both management zones. Ninety percent of the nest sites are within 3.5 miles, and 50 percent of the nest sites are within a 3/4-mile of a major tributary.

Table 16 Distance to Major Tributary

Zone	Mean	S.D.	Min.	50%	75%	90%	Max.
007	1.20 mi.	1.25 mi.	.25 mi.	<.75 mi.	<1.5 mi.	<3 mi.	4 mi.
018	1.00 mi.	.80 mi.	.5 mi.	<.6 mi.	<1.25 mi.	<2 mi.	2.5 mi.
TOTAL	1.20 mi.	1.15 mi.	.25 mi.	<.75 mi.	<1.5 mi.	<3.5 mi.	4 mi.

C. Habitat

Only 7 of the original 9 habitat variables on the Nest Site Description Form are described in this section. We collected insufficient data to include habitat type and PI type in the analysis.

1. Cover Type

We divided cover types into coniferous or deciduous overstories. Seventy-eight percent of the nest sites in both management zones are associated with coniferous overstories. The remaining 22 percent are cottonwood riparian sites. The coniferous use is divided among 4 overstory cover types:

1. 55% have Douglas-fir overstories.
2. 25% have Ponderosa pine overstories.
3. 10% have Lodgepole pine overstories.
4. 10% have Larch overstories.

2. Canopy Closure

The eagles are not using closed stands in either management zone. Seventy-five percent of the nest sites in western Montana have less than 70 percent canopy closure, and the maximum closure for any site is 80 percent (Table 17). Over 1/2 of the nest sites in western Montana fall within a canopy closure of 40 to 70 percent.

Figure 10. Distribution of Distance to Still Water

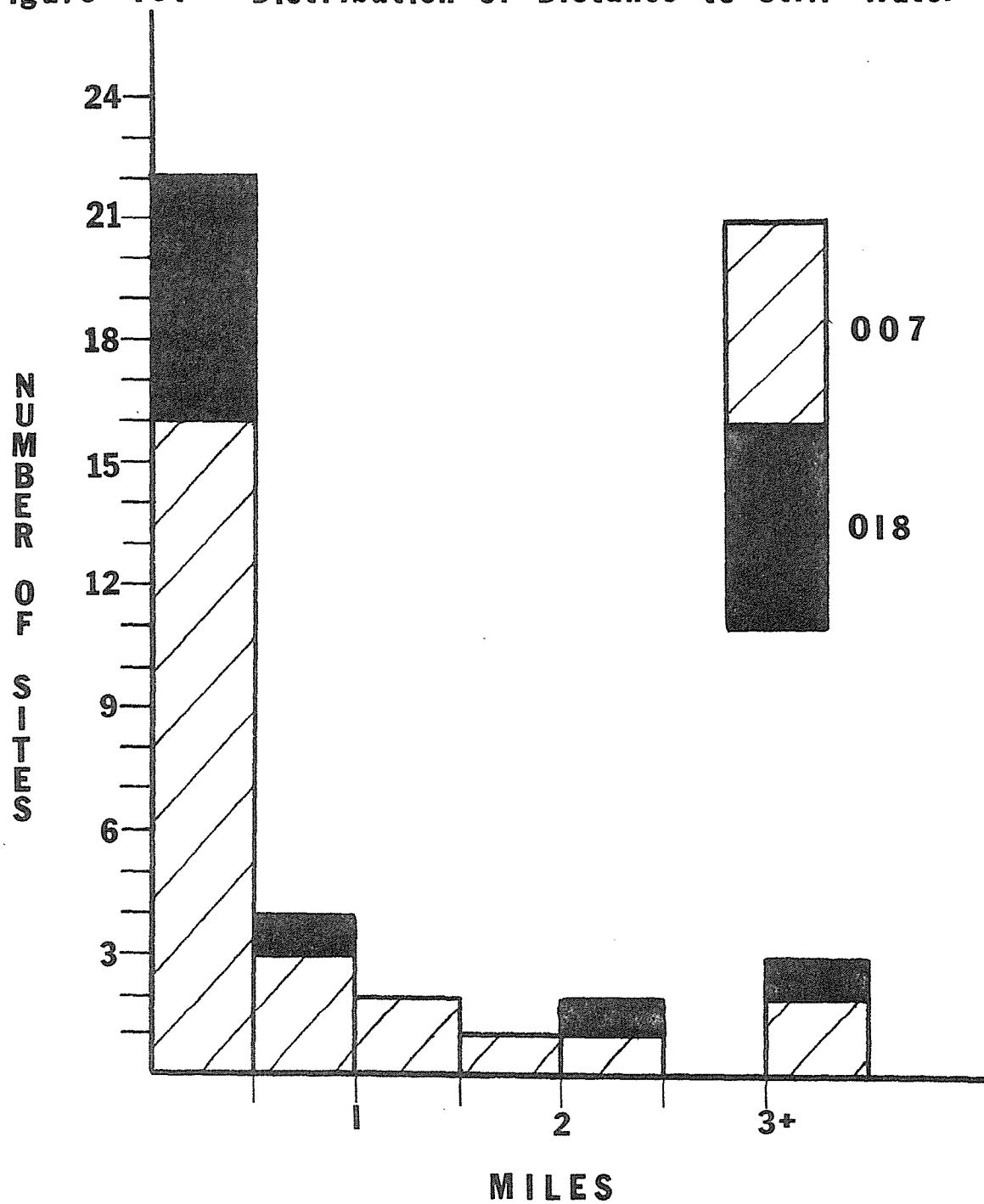


Table 17 Canopy Closure

Zone	Mean	S.D.	Min.	50%	75%	90%	Max
007	52%	23%	1%	<55%	<70%	<80%	80%
018	59%	14%	40%	<60%	<70%	<70%	70%
TOTAL	54%	21%	1%	<60%	<75%	<80%	80%

3. Stand Size

The average size of the homogeneous stand of trees (cover type, age class, and canopy closure) in which the nest tree is found is about 50 acres in both management zones (Table 18). Nest stand size varies over quite a range within both zones (Figure 11). Zone 018 exhibits both larger minimum and smaller maximum nest stand size values, and a greater proportion of the nests are in larger stands than Zone 007 (Table 18).

Table 18 Nest Stand Size

Zone	Mean	S. D.	Min.	50%	75%	90%	Max.
007	48 ac.	51 ac.	3 ac.	>27 ac.	>10 ac.	>3 ac.	225 ac.
018	54 ac.	31 ac.	25 ac.	>44 ac.	>35 ac.	>25 ac.	113 ac.
TOTAL	49 ac.	47 ac.	3 ac.	>30 ac.	>20 ac.	>5 ac.	225 ac.

4. Habitat Composition

Habitat composition within a 3 mile radius of each nest site was stratified into 9 general habitat types (Table 19). The percentage of open conifer, riparian habitat, and open water categories are very similar between both management zones. In contrast, Zone 007 contains much higher percentages of urban, cropland, and closed conifer categories and lower percentages of grassland and shrubland than Zone 018. The dominant category in the composite ranking for both zones together is closed conifer (30%), but 3 of the top 4 categories are open cover types (open conifer, grassland, and open water).

Table 19 Habitat Composition

Zone	OW	URB	CRP	RIP	GL	SL	OC	CC	OTHER
007	11%	3%	8%	5%	11%	0%	19%	34%	9%
018	7%	0%	0%	5%	40%	7%	19%	17%	5%
COMPOSITE	10%	2%	6%	5%	18%	2%	19%	30%	8%

OW = Open Water

URB = Urban

CRP = Cropland

RIP = Riparian

GL = Grasslands

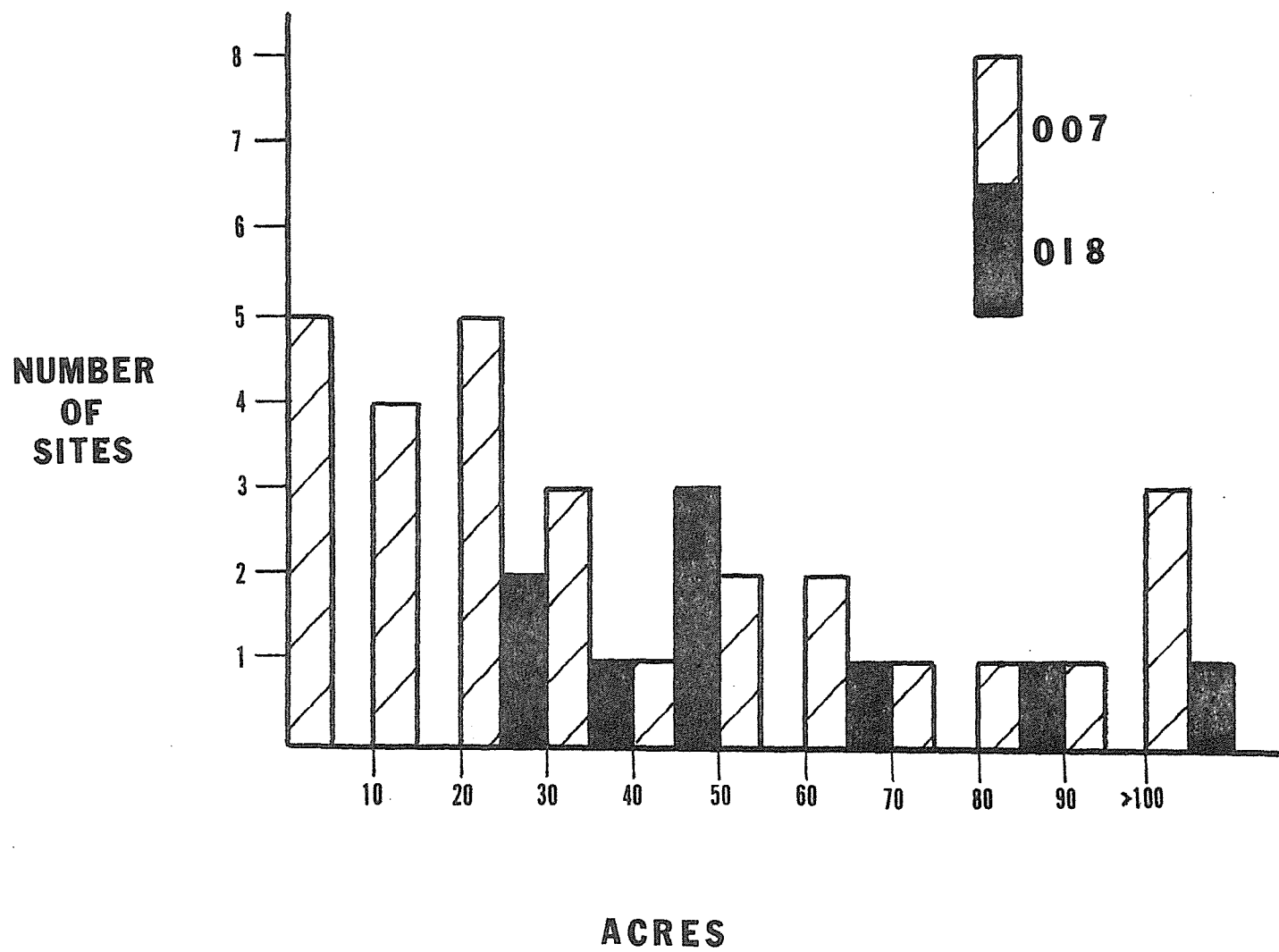
SL = Shrubland

OC = Open Conifer (<70% closure)

CC = Closed Conifer (>70% closure)

NOTE: The above are average values within each zone, and weighted averages for the composite category.

Figure II. Distribution of Stand Size



5. Habitat Turnovers

The number of habitat turnovers recorded along 4, 3 mile transects is used as an index of habitat diversity within the nesting territory. Table 20 shows the average number of habitat turnovers for each cardinal direction, and Table 21 shows the average total number of turnovers for each management zone. No pattern is apparent between the number of turnovers and direction from the nest (Table 20). Nest sites in Zone 018 are more vegetatively diverse than Zone 007 nest sites (Table 21).

Table 20 Number of Habitat Turnovers

Zone	North	South	East	West	Total
007	4 (0-16)	4 (1-18)	4 (0-11)	4 (0-20)	17 (6-56)
018	6 (0-9)	7 (3-18)	5 (2-8)	7 (1-14)	24 (9-44)

NOTE: Range of values shown in parentheses

Table 21 Habitat Turnover Distribution

Zone	Mean	St. D.	Min.	50%	75%	90%	Max.
007	17	10.8	6	>15	>8	>6	56
018	24	12.6	9	>20	>14	>9	44

6. Distance to Nearest Habitat Turnover

Nest sites within both management zones are located close to a habitat turnover (edge). Ninety percent of the nests are within 550 feet of an edge (Table 22). Nest sites within Zone 018 are almost twice as close to a habitat edge than the Zone 007 nest sites. Only 50 percent of the Zone 007 nests are within 400 feet of an edge, while 90 percent of the Zone 018 nests are within 400 feet of an edge.

Table 22 Distance to Habitat Turnover

Zone	Mean	St. D.	Min.	50%	75%	90%	Max.
007	372 ft.	288 ft.	1 ft.	<400 ft	<500 ft	<800 ft	999 ft.
018	221 ft.	163 ft.	10 ft.	<150 ft	<350 ft	<400 ft	500 ft.
TOTAL	335 ft.	269 ft.	1 ft.	<225 ft	<425 ft	<550 ft	999 ft.

7. Direction to Habitat Turnover

The direction to the nearest habitat turnover (edge) is essentially random ($r = .13$) for Zone 007 nest sites, but are generally northerly ($r = .61$) for Zone 018 nests (Figure 12). The mean vector length (r) is a relative measure of concentration, and is measured on a scale from 0 (random) to 1 (all points in the same direction).

D. Potential Disturbances

A number of measurements were made relating both the proximity and the density of various human disturbance variables to the individual nest sites. The disturbance variables are separated into 3 general categories: (1) distances to disturbance points, (2) quantities of disturbance variables within the nesting territory, and (3) types and sizes of timber harvest activities.

The disturbance variables quantified by distance include transportation routes, residences, recreation areas, and power lines. We made 3 measurements for each variable--the point of the disturbance variable closest to the nest site (1) below the nest elevation, (2) even with the nest elevation, and (3) above the nest elevation.

The disturbance variables described by quantity within the nesting territory include transportation routes, permanent structures, and percent of shoreline development. Two analysis areas were completed for each variable: (1) 1 mile radius from the nest site, and (2) 3 mile radius from the nest site.

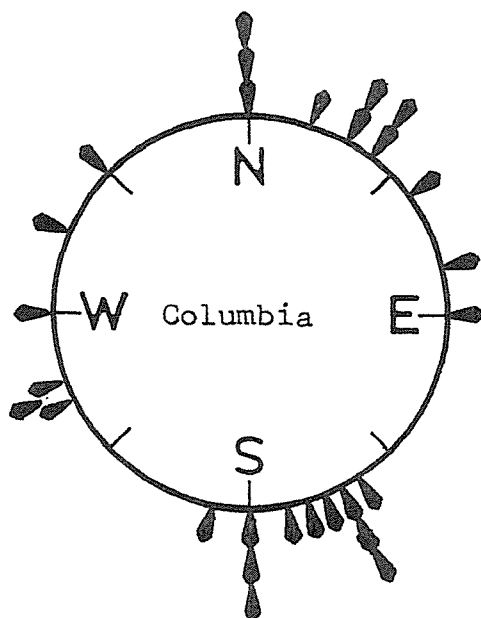
1. Distance to Transportation Routes

Distance to transportation routes appear to be important variables in nest site habitat descriptions. Thirty-five of the 36 (97%) measurements average greater than 2 miles from the nest site, and the variables exhibit relatively low variation (Table 23). Nest sites in Zone 018 average further from human transportation factors than Zone 007 nest sites. Several patterns are evident in the data presented on Table 23: (1) average distances to nearest transportation route are greater when below the nest; and (2) within the road categories primitive roads average closer to the nest.

Table 23 Distance to Transportation Routes

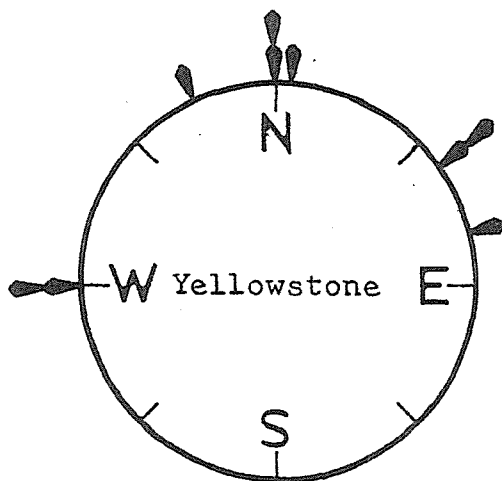
ZONE 007			
Category	Below Nest	Even With	Above Nest
Major Highway	2.90 (0.46)	2.38 (1.02)	2.78 (0.61)
Primary Road	2.65 (0.79)	2.65 (0.79)	2.41 (1.01)
Secondary Road	2.72 (0.82)	2.39 (1.03)	2.35 (1.03)
Primitive Road	2.69 (0.91)	2.15 (1.23)	2.19 (1.18)
Trail	2.74 (0.79)	2.71 (0.85)	2.64 (0.91)
Railroad	2.84 (0.55)	2.86 (0.51)	2.76 (0.73)
ZONE 018			
	Below Nest	Even With	Above Nest
Major Highway	2.41 (1.17)	3.00 (0.00)	3.00 (0.00)
Primary Road	2.69 (0.93)	3.00 (0.00)	3.00 (0.00)
Secondary Road	2.76 (0.73)	2.69 (0.93)	3.00 (0.00)
Primitive Road	1.75 (1.49)	2.71 (0.87)	2.82 (0.59)
Trail	2.68 (0.97)	3.00 (0.00)	2.51 (0.98)
Railroad	3.00 (0.00)	3.00 (0.00)	3.00 (0.00)

Figure 12. Direction to Nearest Habitat Turnover



$\bar{x} = 314$
 $r = .13$
 A.V. = 76

\bar{x} = mean direction
 r = mean vector length
 A.V. = angular variation



$\bar{x} = 3$
 $r = .61$
 A.V. = 51

2. Distance to Other Human Disturbances

Distances to other sources of disturbances were similar to the distances to transportation routes (Table 24). Twenty-three of the 24 (96%) measurements average greater than 2 miles from the nest site, and the variables exhibit relatively low variation. Nest sites in Zone 018 generally average further from other sources of disturbance than Zone 007 nest sites. The number of power lines found within 3 miles of a nest site are so few the results are questionable. Seventy-three percent of the "other" (misc.) entries are either fire lookouts or gravel pits. The average distances to nearest other source of disturbance is generally greater when below the nest (Table 24), this is the same basic pattern found in the distance to transportation route data (Table 23).

Table 24 Distance To Other Source of Disturbance

007 SITES			
	Below Nest	Even With	Above Nest
Power Line	3.00 (0.00)	2.35 (1.08)	2.75 (0.69)
Residence	2.57 (0.94)	2.08 (1.07)	2.42 (0.95)
Recreation Site	2.68 (0.81)	2.66 (1.51)	2.79 (0.62)
Other	3.00 (0.00)	2.72 (0.74)	2.78 (0.59)

018 SITES			
	Below Nest	Even With	Above Nest
Power Line	3.00 (0.00)	3.00 (0.00)	3.00 (0.00)
Residence	1.90 (1.21)	2.70 (0.90)	2.68 (0.95)
Recreation Site	2.20 (1.19)	2.76 (0.73)	3.00 (0.00)
Other	2.37 (1.25)	3.00 (0.00)	2.71 (0.87)

3. Quantities of Transportation Routes

We measured the number of miles of each road class that occurs within a 1 mile and 3 mile radius of the nest site (Table 25). The 018 Zone averages fewer miles of roads in every class but primitive road. The only pattern evident from Table 25 is that as the class of road increases the miles of road decreases. This is not surprising because fewer miles of highway are constructed than primary roads, and so forth.

Table 25 Miles of Transportation Routes

007 SITES		
	1-Mile Radius	3-Mile Radius
Major Highway	0.41 mi. (0.74) 0.00 - 2.30 mi.	3.08 mi. (3.21) 0.00 - 9.50 mi.
Primary Road	0.77 mi. (1.35) 0.00 - 5.50 mi.	6.63 mi. (8.23) 0.00 - 34.5 mi.
Secondary Road	1.11 mi. (1.58) 0.00 - 5.50 mi.	10.4 mi. (8.06) 0.00 - 30.7 mi.
Primitive Road	1.39 mi. (1.48) 0.00 - 5.00 mi.	11.6 mi. (10.5) 0.00 - 33.0 mi.

018 SITES		
	1-Mile Radius	3-Mile Radius
Major Highway	0.37 mi. (0.66) 0.00 - 1.90 mi.	2.47 mi. (3.77) 0.00 - 9.00 mi.
Primary Road	0.39 mi. (1.17) 0.00 - 3.50 mi.	2.54 mi. (6.58) 0.00 - 20.0 mi.
Secondary Road	0.46 mi. (0.85) 0.00 - 2.50 mi.	5.82 mi. (5.85) 0.00 - 18.0 mi.
Primitive Road	2.12 mi. (1.64) 0.00 - 3.60 mi.	12.5 mi. (7.32) 1.00 - 22.3 mi.

Note: Each cell lists the mean and the standard deviation (in parentheses) on the top line, and the minimum and maximum measurements on the second line.

4. Permanent Structures

We measured the number of permanent structures within a 1 mile and 3 mile radius of the nest site (Table 26)

Table 26 Number of Permanent Structures

ZONE	MEAN	ST.D.	MIN	50%	75%	90%	MAX
007							
1 mile radius	2.7	4.6	0	equals 0	<3	<10	14
3 mile radius	37	65	0	<15	<35	<75	300
018							
1 mile radius	1.9	3	0	equals 0	<3	<9	9
3 mile radius	12	15.2	1	<6	<14	<30	46
TOTAL							
1 mile radius	2.5	4.2	0	equals 0	<3	<10	14
3 mile radius	30.9	57.9	0	<10	<30	<70	300

5. Developed shoreline

The amount of associated water body shoreline development (permanent human presence) within 1 mile and 3 miles of bald eagle nest sites is shown in Table 27. Shoreline development within both zones is very limited within 1 mile of the nest site. One half the nests have no shoreline development, and 90 percent of the nests have less than 5 percent shoreline development within 1 mile of the nest. Zone 018 nest sites average slightly less shoreline development than Zone 007 nests.

Table 27 Percent Shoreline Development

ZONE	MEAN	ST.D.	MIN	50%	75%	90%	MAX
007							
1 mile radius	2.3%	6.7%	0%	equal 0%	<1%	<5%	35%
3 mile radius	6.4%	9.9%	0%	<5%	<5%	<15%	45%
018							
1 mile radius	1.6%	9.0%	0%	equal 0%	<1%	<5%	5%
3 mile radius	5.0%	4.4%	0%	<5%	<10%	<10%	10%
TOTAL							
1 mile radius	1.95%	5.9%	0%	equal 0%	<1%	<5%	35%
3 mile radius	6.1%	8.9%	0%	<5%	<7%	<15%	42%

6. Timber Harvest Activities

We measured various types of timber harvest associated with each nest site by type of cut, percentage of the analysis area cut, and distance of the cut from the nest site. Three zones were analyzed for timber harvest: (1) within the nest stand; (2) within 1/4-mile of the nest; and (3) within 1/2-mile of the nest.

The first analysis level was within the nest stand. Five (18%) of the Zone 007 nest stands showed evidence of timber harvest activity, while none of the Zone 018 nest stands were cut. In each of these 5 stands timber harvest occurred greater than 1/10-mile from the nest tree. Two nest stands were clear cut on 35 and 80 percent of their associated stands. Two were partial cut involving less than 5 percent of the associated stands. Less than 5 percent of the fifth was cleared for a power line.

Table 28 summarizes the timber harvest activity within 1/4 and 1/2-mile of the nest site. Zone 007 nests are affected by cutting activities both more frequently and more heavily. Roughly 1/3 the Zone 007 nests showed evidence of timber harvest within 1/4-mile (8% average affected area), and over 1/2 showed evidence of timber harvest within 1/2-mile (12% average affected area) of the nest.

Table 28 Timber Harvest Activities

ZONE	Within 1/4 Mile	Within 1/2 Mile
007	32.1% sites cut 8% a.a.a.	53.6% sites cut 12% a.a.a.
018	22.0% sites cut 3% a.a.a.	33.0% sites cut 4% a.a.a.

a.a.a. = average affected area

E. Land Status

Two variables are included under Land Status: (1) nest stand ownership, and (2) percent of the nesting territory in private land. These are important descriptive variables when considering management implications and the immediate security of the nest site.

1. Nest Stand Ownership

Table 29 shows the distribution of nest stand ownership by 8 owner categories. Over 1/2 of the nest stands in both zones are in public ownership (56%), and most of this is comprised of federal lands. Most of the nests in private ownership are in other than large corporate ownership. All of the Zone 018 nests are on public lands (all federal), while only 44 percent of the sites in Zone 007 are on public lands (state and federal).

Table 29 Nest Stand Ownership

ZONE	Government					Private			
	State	USFS	USFWS	NPS	BLM	CHMPN	StREG	BN	PRVATE
007	4	5	2	2	0	2	2	1	12
	13%	17%	7%	7%	0%	7%	7%	3%	40%
018	0	7	0	0	2	0	0	0	0
	0%	78%	0%	0%	2%	0%	0%	0%	0%
TOTAL	4	12	2	2	2	2	2	1	12
	10%	31%	5%	5%	5%	5%	5%	3%	31%

State = State of Montana
 USFS = US Forest Service
 USFWS = US Fish, Wildlife & Parks
 NPS = National Park Service
 BLM = Bureau of Land Management

CHMPN = Champion International
 StREG = St. Regis
 BN = Burlington Northern
 PRVATE = Private owners

2. Percent Private Land

Table 30 shows the percent private land within a 1 mile and 3 mile radius of the nest site. Management Zone 007 nests average more than twice the amount of private land within both a 1 and 3 mile radius of the nest than Zone 018 nests. The amount of private land is similar between both distance zones around nest sites (Figures 13 and 14). Overall, virtually all nests have some private land involved within a 1 or 3 mile radius of a nest, and 1/2 of the nests are more than 1/3 private land within a 3 mile radius of the nest (Table 30).

Table 30 Percent Private Land

ZONE	MEAN	ST.D.	MIN	50%	75%	90%	MAX
007							
1 mile radius	49.4%	40.9%	0%	>45%	> 4%	> 0%	100%
3 mile radius	50.5%	35.1%	0%	>50%	>10%	> 0%	99%
018							
1 mile radius	19%	29.4%	0%	>10%	> 0%	> 0%	94%
3 mile radius	23.9%	21.1%	0%	>20%	> 1%	> 0%	69%
TOTAL							
1 mile radius	42%	40.2%	0%	>25%	> 4%	> 0%	100%
3 mile radius	44%	34%	0%	>35%	>10%	> 0%	99%

F. Territory Interspersion

Straight-line distances were measured to the nearest occupied bald eagle nest site. Figure 15 shows the distribution of the nearest neighbor distances. Nest sites within Management Zone 018 average closer together than Zone 007 nests. Overall the average distance between nests in both management zones is about 9 miles, and 3/4 of the nests are less than 10 miles apart (Table 31).

Table 31 Nearest Neighbor Distance

Zone	Mean	St. D.	Min.	50%	75%	90%	Max.
007	10.6 mi	8.2 mi	2 mi	<8 mi	<12 mi	<20 mi	40 mi
018	5.1 mi	2.3 mi	4 mi	<4 mi	< 5 mi	<11 mi	11 mi
TOTAL	9.2 mi	7.5 mi	2 mi	<6 mi	<10 mi	<20 mi	40 mi

G. Variable Correlations

Correlation analysis was completed on 7 variable sets which appeared to have possible relationships: (1) slope and position on slope; (2) elevation and average annual snowfall; (3) elevation above associated water body and distance from associated water body; (4) stream miles and shoreline miles; (5) road use categories and elevation-to-nest; (6) other sources of disturbance and elevation-to-nest; and (7) linear sources of disturbance (roads) and point sources of disturbance (permanent structures and recreation sites). Basically little or no correlations were found between (1) slope and position on slope ($r = -0.069$), (2) elevation and snowfall ($r = -0.128$), (3) elevation above associated water body and distance from associated water body ($r = 0.22$), and (7) linear and point sources of disturbance ($r = -0.017$ to 0.061). Pearson's correlation coefficient (r) relating two variables is on a absolute scale of 0 (no correlation) to 1.0. The following is a discussion of those variables which did show strong correlations.

PERCENT OF TERRITORY IN PRIVATE LAND (BOTH)

Figure 13. 1 Mile Radius

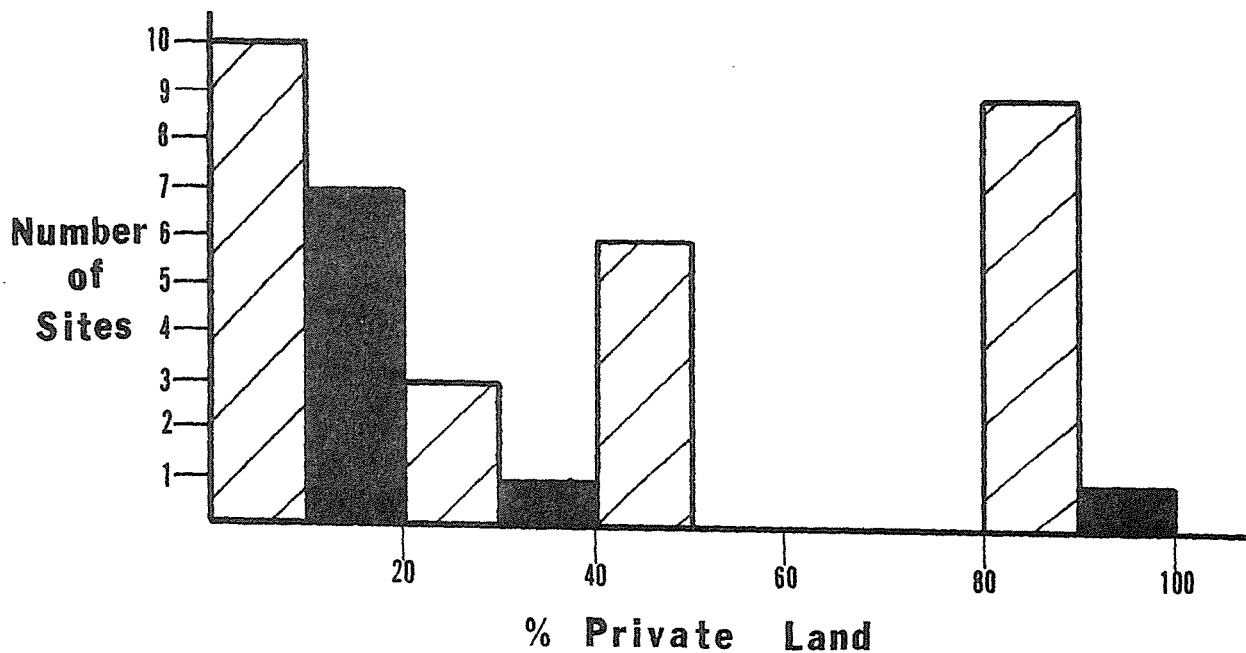
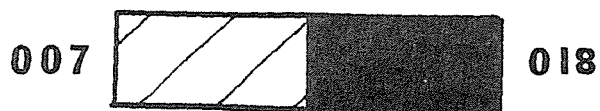
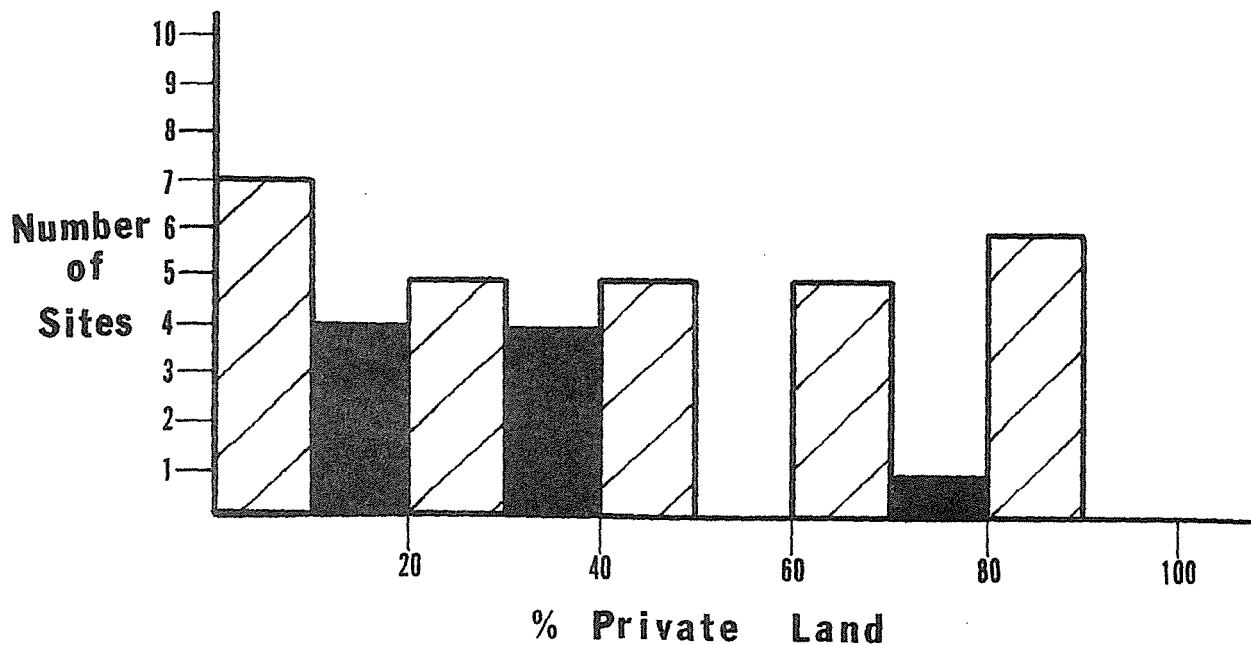


Figure 14. 3 Mile Radius



1. Correlation between still water shoreline and major stream miles

The amount of shoreline miles and amount of major stream miles within a 3 mile radius of the nest showed a strong negative correlation ($r = -0.613$). That is, nest sites with high shoreline miles had low stream miles and vice versa. Therefore, we can view these interrelated variables together as total aquatic shoreline miles. This composite category would better measure the availability of water associated habitat at the nest site. The correlation coefficients between the total aquatic miles and shoreline miles, and total aquatic shoreline miles and stream miles is $r = 0.525$ and $r = 0.351$ respectively. Table 32 shows the distribution of the total aquatic miles within a 3 mile radius of all the nests surveyed.

Table 32 Total Aquatic Shoreline Miles

Zone	Mean	St. D.	Min.	50%	75%	90%	Max.
TOTAL	11.3 mi	5.1 mi	1.5mi	>10 mi	>7 mi	>6 mi	26 mi

2. Correlation between road use categories and elevation-to-nest

A correlation matrix was generated for all 12 of the road/elevation-to-nest categories; e.g. highway/below and primitive road/above. The 3 highest use road categories (highway, primary road, and secondary road) showed absolute correlation ($r = 1.0$) within each of the elevation-to-nest groups (below, even, and above), while correlation between primitive roads and other road categories within those groups was low ($r = 0.077$ to 0.391). This suggests that the 4 road use categories can be lumped into 2 categories: (1) including only primitive roads and (2) including highways, primary roads, and secondary roads. Table 33 shows the distribution of the distance measurements of the nearest road for the two road use categories discussed above. The same patterns shown on Table 23, Distances to Transportation Routes are evident on Table 33; that (1) the distance to nearest road are greater when below the nest, and (2) primitive roads are closer to the nest then other road categories. Ninety percent of the nests in both zones are greater then a 1/2-mile from a non-primitive road below the nest elevation, and 1/4-mile from a non-primitive road even with or above the nest elevation. Seventy-five percent of the nests are greater then 1/2-mile from a non-primitive road regardless of elevation.

Figure 15. Distance to Nearest Neighbor Distribution

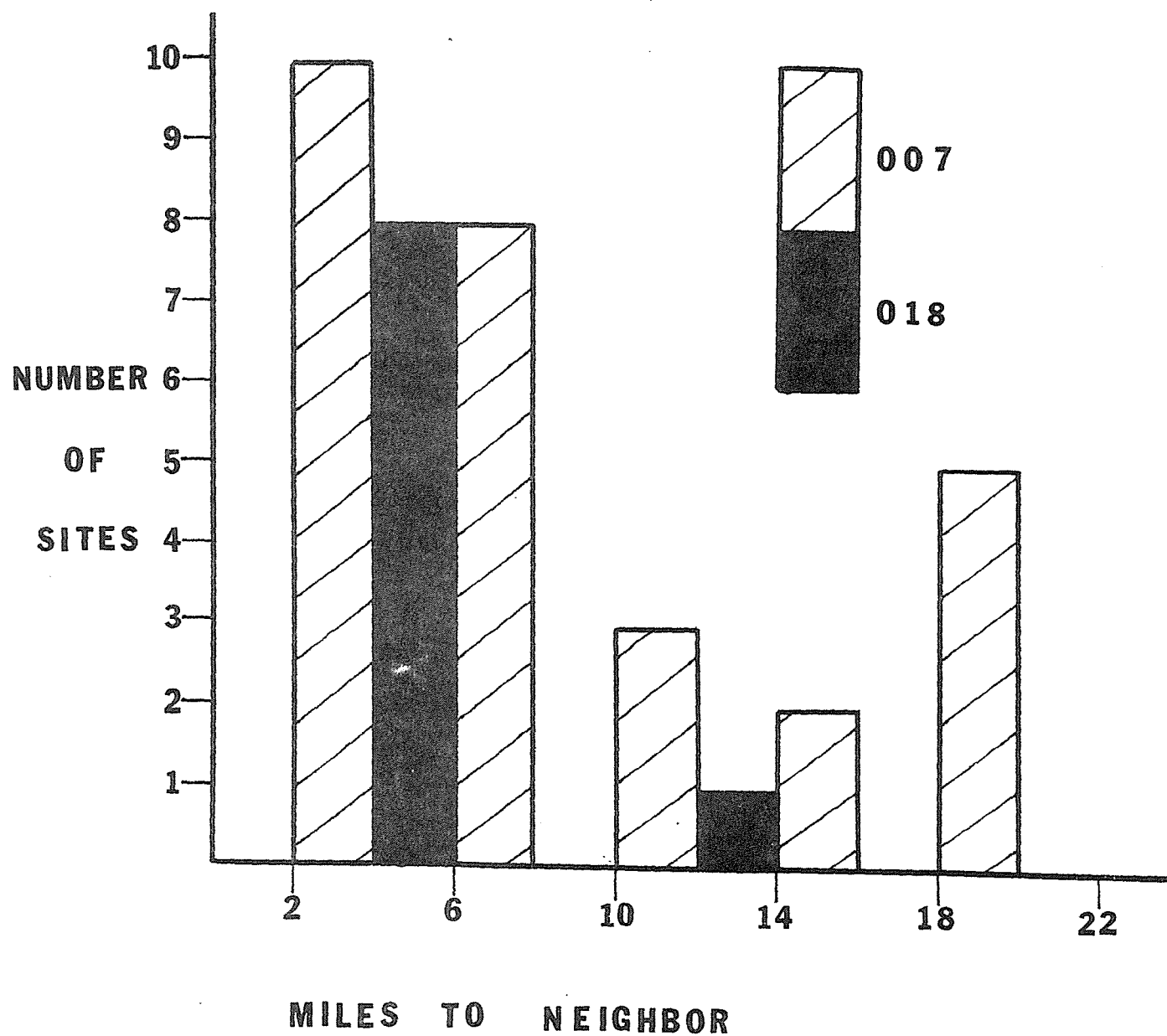


Table 33 Distance to Nearest Road

BELOW THE NEST THE NEST ELEVATION							
Catagory	Mean	SD	Min.	50%	75%	90%	max.
Other Roads	2.65 mi	.88	.2 mi	>3 mi	>2.64 mi	>.5 mi	3 mi
Primitive	2.46 mi	1.1	.04 mi	>3 mi	>3 mi	>.1 mi	3 mi

ABOVE OR EVEN WITH NEST ELEVATION							
Catagory	Mean	SD	Min.	50%	75%	90%	max.
Other Roads	2.34 mi	1.1	.2 mi	>3 mi	>1.25 mi	>.25 mi	3 mi
Primitive	1.77 mi	1.3	.02 mi	>2.0 mi	>.3 mi	>.1 mi	3 mi

REGARDLESS OF ELEVATION							
Catagory	Mean	SD	Min.	50%	75%	90%	max.
Other Roads	1.99 mi	1.2	.2 mi	>2.75 mi	>.5 mi	>.2 mi	3 mi
Primitive	1.23 mi	1.3	.02 mi	>.4 mi	>.15 mi	>.05 mi	3 mi

3. Correlation between other sources of disturbance and elevation to nest

A correlation matrix was generated for all 6 of the other source of disturbance/elevation-to-nest categories; e.g. residence/below the nest and recreation site/above the nest. The results are similar to that found with transportation routes: a strong correlation ($r = 0.64$) within the elevation groups and a poor correlation within activity groups ($r = -.43$ to $.19$). This suggests that these activities can be lumped into 1 activity category including all the point activities. Table 34 shows the distribution of the distance measurements for the nearest point activity to a nest. Nests average further from point activities when they are below the nest. Ninety percent of the nests are greater than 1/2-mile from point activities below the nest elevation and greater than 1/4-mile from point sources even or above the nest elevation. Seventy-five percent of the nests are greater than 3/10-mile from a point activity regardless of elevation to nest.

Table 34 Distance to Nearest Point Activity

Elev.Category	Mean	SD	Min.	50%	75%	90%	max.
BELOW NEST	1.97 mi	1.1	.15 mi	>2.75 mi	>.75 mi	>.5 mi	3 mi
EVEN/ABOVE NEST	1.82 mi	1.1	.1 mi	>1.5 mi	>.7 mi	>.25 mi	3 mi
ANY ELEVATION	1.31 mi	1.0	.1 mi	>1.0 mi	>.3 mi	>.13 mi	3 mi

IV. DISCUSSION

Out of the 68 variables included in the macro-habitat survey, 56 were included in the analysis. Twenty-four variables appear to be important macro-habitat descriptors (Table 35). One aspect that has not been measured adequately in this analysis, because of the inability to quantify these variables, is prey availability and quality. Every nest site surveyed was within topographic line-of-sight of the associated water body. This was the only variable which showed no variation. There are 6 variables which show obvious thresholds or limits on bald eagle habitat use in these 2 management zones: snowfall, slope, distance to associated water body, elevation above associated water body, associated water body size, and nest stand size. In addition, 12 variables show distinctive patterns which could be useful in defining bald eagle nest site selection: nest tree species, position on slope, aspect, type of associated water body, aquatic shoreline miles, distance to major tributary, canopy closure, distance to transportation routes, distance to other human disturbances, quantities of transportation routes, number of permanent structures, and amount of developed shoreline. None of the "direction to" variables show any apparent patterns: direction to associated water body, direction to greater than fourth order stream, direction to still water, and direction to habitat turnover. There are 4 variables which are primarily descriptive and may not be helpful in defining nest site selection: elevation, cover type, nest stand ownership, and percent private land.

Based on the correlation analysis, several of the original variables can be combined and/or represented by another variable. Miles of aquatic shoreline within a 3 mile radius can replace 4 original variables: shoreline miles, major stream miles, distance to major stream, and distance to lake or reservoir. Aquatic shoreline is the combination of shoreline and major stream miles and should be an index to the amount of aquatic feeding habitat available within a territory. Originally distance to transportation routes included 6 individual variables: major highway, primary road, secondary road, primitive road, trail, and railroad. Each of these categories includes 3 elevation-to-nest categories: above nest, even with nest, and below nest. This results in 18 possible variable sets. Our analysis shows that the 4 road categories can be reduced to 2: primitive roads and other roads, or more appropriately, closed roads and open roads in relation to the nesting season. The 3 elevation-to-nest categories can also be reduced to 2: below the nest and even with or above the nest. Bald eagle nests average closer to primitive roads than other road categories, and average further from transportation routes below the nest than other elevation categories. Originally distance to other human disturbances included 4 categories: residence, recreation site, power line, and other. Each of these categories also included the 3 elevation-to-nest categories mentioned with transportation routes. Our analysis shows that the 4 other human disturbance categories can be reduced to 1 category: point activities, and the elevation-to-nest categories can be reduced to the same 2 variables mentioned above: below the nest and even with or above the nest. The reduction in the number of road categories applies to the quantities of transportation route variables as well.

The patterns exhibited by most of the macro-habitat variables measured indicate that (1) bald eagles in these 2 management zones are not reacting to their environment passively, (2) macro-habitat variables are helpful in describing bald eagle nest site selection, and (3) macro-habitat analysis can serve as a base for predicting or rating bald eagle nesting habitat.

V. SUMMARY

All of the nests in the Upper Columbia (Zone 007) and Greater Yellowstone (Zone 018) Bald Eagle Management Zones occur within 1 mile of a lake or reservoir greater than 40 acres, or stream greater than fourth order in size. All nests within these 2 zones are within topographic line-of-sight and within 600 feet elevation of the associated water body. All of the nests in these 2 zones occur in areas with less than 300 inches average annual snowfall, and on less than 64 percent slopes. The closest occupied nests are 2 miles apart. Nests in these 2 zones are most often found on flat to moderate slopes, with northerly aspects, and within 1/4-mile of water. Eagles nest near major tributaries and away from human activities in both zones. Avoidance of human activities is most pronounced when the source of disturbance is between the nest and associated water body. Still water nest sites are more closely associated with the inlet to the lake or reservoir, than the outlet to the water body.

Nest sites within Zone 018 are on steeper slopes, higher elevations, associated with more grasslands, and are more vegetatively diverse on the average than nests within Zone 007. Nests within Zone 018 are more isolated from human activities, and are involved with less private land than Zone 007 nests.

A summary of the important variables for all the nest sites surveyed is shown on Table 35. A typical (average) bald eagle nest site would be represented by the mean values in the second column of this table. The limits of habitat variable use (suitability) are represented by the minimum (Min.) and maximum (Max.) values in columns 4 and 8 of this table. The 50%, 75%, and 90% columns represent our best estimate of preferred bald eagle nesting habitat in the 2 zones. The 50% distribution column represents the most specific and the 90% the broadest portions of the preferred range of values.

Table 35 Summary

Variable	Mean	SD	Min.	50%	75%	90%	max.
snowfall	100.6 in	63	<50 in	<100 in	<200 in	<300 in	<300 in
nest trees	-	-	-	DF&PP	conifer	conifer&cottonwood	
aspect	10 deg.	-	-	<45 >350	<60 >340	<70 >300	-
slope	17 %	20%	0 %	<10%	<30 %	<40 %	64 %
position on slope	-	-	flat	lower 1/3	lower 1/2	below ridge top	ridge top
AWB type	-	-	-	lakes	lake&res.	lake,res. and river	
stillwater AWB size	-	-	41 ac.	>1000 ac.	>300 ac.	>100 ac.	126000 ac
running AWB size	all nest sites associated with running AWP are on rivers greater than fourth order in size						
distance to AWB	1027 ft	1216	1 ft.	<1000 ft	<1500 ft	<2000 ft	5280 ft
elevation above AWP	101 ft.	129	4 ft.	<56 ft.	<140 ft.	<260 ft.	567 ft.
line-of-sight	all nest sites were within topographic line-of-sight of AWP						
aquatic shoreline	11.3 mi.	5.1	1.5 mi.	>10 mi.	>7 mi.	>6 mi.	26 mi.
distance to major trib.	1.2 mi	1.15	.25 mi.	<.75 mi.	<1.5 mi.	<3.5 mi.	4 mi.
canopy closure	54 %	21%	1 %	<60 %	<75 %	<80 %	80 %
stand size	49 ac.	47	3 ac.	>30 ac.	>20 ac.	>5 ac.	225 ac.
distance to edge	335 ft.	269	1 ft.	<225 ft.	<425 ft.	<550 ft.	999 ft.
distance to primitive road	1.23 mi.	1.3	.02 mi.	>.4 mi.	>.15 mi.	>.05 mi.	3 mi.
distance to other roads	1.99 mi.	1.2	.2 mi.	>2.75 mi.	>.5 mi.	>.2 mi.	3 mi.
distance to point activity	1.33 mi.	1.0	.1 mi.	>1.0 mi.	>.3 mi.	>.13 mi.	3 mi.
miles of other roads (3 mi)	17.85 mi	11.5	1 mi.	<17 mi.	<25 mi.	<34 mi.	52 mi.
number of perm structures(3mi	30	58	0	<12	<38	<70	300
% shore (1 mi) development	1.95 %	5.9%	0 %	equal 0%	<1 %	<5 %	35 %
% private land (3 mi.)	44 %	34%	0 %	>35 %	>10 %	>0 %	99 %
nearest neighbor	9.2 mi.	7.5	2 mi.	<6 mi.	<10 mi.	<20 mi.	40 mi.

VI. Literature Cited

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APPENDIX I

Nest-Site Description Form
and
Definitions and Instructions

Bald Eagle Nest Site Description

Definitions and Instructions

- I. Level I - Macrohabitat description. Information from aerial photos and various maps. All points of reference are the nest site unless otherwise noted.

<u>Definition</u>	<u>Source</u>
A.1. <u>Province</u> - as defined by Bailey (1978)	Subsection Map
2. <u>Subsection</u> - Land System Inventory Unit	Subsection Map (1:500,000)
3. <u>Landtype</u> - Land System Inventory Unit	Forest Landtype Map
4. <u>Hydrologic Unit</u> - 10 digit number	Hydrologic Map of MT
5. <u>Elevation</u> - feet above sea level	USGS Topo Quad
6. <u>Aspect</u> - Compass degrees of the general slope the nest is on faces. If flat so note.	USGS Topo Quad
7. <u>Slope</u> - The general slope in percent the nest is on.	USGS Topo Quad
8. <u>Position on Slope</u> - Circle most appropriate category.	USGS Topo Quad
9. <u>Associated Water Body,(AWB)</u> - Identify the type (e.g., lake, reservoir, marsh, river) and size (surface acre or stream order) of the water body the nest is adjacent to.	USGS Topo Quad
10. <u>Direction</u> (in degrees) and <u>distance</u> in miles to AWB at closest point from the nest. If < .10 mile identify in feet.	USGS Topo Quad
11. Elevation in feet the nest is above the AWB.	USGS Topo Quad
12. Don't consider avegetation barriers	USGS Topo Quad
13. Direction (in degrees) and distance (miles) to closest larger than 4th order stream.	USGS Topo Quad
14. Total >4th order stream miles within a 3-mile radius of the nest.	USGS Topo Quad
15. Direction (in degrees) and distance (miles) to closest open water (lake/reservoir).	USGS Topo Quad
16. Total lake/reservoir shoreline miles within a 3-mile radius of the nest.	USGS Topo Quad
B.1. Potential vegetation (e.g. Pfister, 1975)	Forest Habitat Type Map
2. Existing vegetation	Timber Type or vegetation map for Forest
3. As defined by Forest data base	Forest Data Base
4. Tree canopy closure at nest	Aerial photo, PI Type or Stand Exam
5. Size (acres) of the homogenous vegetation unit the nest is within	Aerial photo or Stand Exam
6. General habitat composition to nearest 10%, if <10% use 0, 1%, or 5% categories.	Aerial photo

Bald Eagle Nest Site Description

2

7. Record the number of times a change in habitat (types listed in #6) occurs.
Record for each direction (4) from the nest.

Aerial photo

8. Direction (in degrees) and distance (miles) to nearest edge from the nest.

Aerial photo

C. Three mile maximum distance for analysis.

1. For each transportation route and elevation category listed within topographic line-of-sight of the nest identify distance (tenths of a mile) at closest point to the nest. Road categories as defined on General Forest Map legend.
2. Road density (miles) for each road type (4) within 1 mile and 3 mile radius of nest.

USGS Topo Quad
General Forest Map

USGS Topo Quad
General Forest Map

3. Same as #1. Sites defined on General Forest Map legend.

USGS Topo Quad
General Forest Map
General Forest Map

4. Number of residences (shown on General Forest Map) within 1 mile and 3 mile radius of nest.

5. Percent calculation of amount of AWB shoreline with human developments. If AWB is less than 6 shoreline miles in extent use total shoreline.

USGS Topo Quad
General Forest Map

6. Amount of Recreation Visitor Days (RVD's) by month.

Recreation Data Base

7. Differentiate between clearcut (CC) and partial cuts in calculations.

Aerial photo
Timber Data Base

D.1 and 2. Differentiate between ownership per General Forest Map legend.

General Forest Map

3. Special Management Areas include Wilderness, Proposed Wilderness, Wilderness Study Areas, Research Natural Areas, Wild and Scenic Rivers, etc. Allocation per Forest Plan.

General Forest Map
Forest Data Base

4. If stand exam data is available for nest get a printout.

Timber Data Base

5. Calculate percent of area within 1 mile and 3 mile radius of nest in private land (all categories of private land).

General Forest Map

6. If aquatic/fish data is available for AWB get a printout.

Inter-Agency Aquatic Data Base

E.1 and 2. Distance in miles

Bald Eagle Working Group
Local Biologist

3. Documentation of a previous nest that no longer exists. Analyze in time sequence.

4. Distance in miles

Local Biologist

5. Document anything unique about the territory. Any concentrated food sources within 3 miles of nest? (e.g. spawning areas, big game winter range.)

Local Biologist

*Ron
maj hwy = 10th hwy
10th rd = 20th hwy +
10th access
20th rd = improved
primitive = primitive*

Territory Name: _____

Territory/Nest Number: _____

I. Level I (Macrohabitat)

A. Physical/Topography

1. Province: _____

2. Subsection: _____

3. Landtype: _____

4. Hydrologic Unit: _____

5. Elevation: _____

6. Aspect: _____

7. Slope: _____

8. Position on Slope: Flat Ridge Top Upper Third
 Mid-slope Lower Third

9. Type and size of associated water body (AWB): _____

10. Direction and distance to AWB: _____

11. Elevation above AWB: _____

12. Nest within topographic line-of-sight of AWB: yes no

13. Direction and distance to > 4th order stream: _____

14. > 4th order stream miles within 3-mile radius of nest: _____

15. Direction and distance to lake or reservoir: _____

16. Lake/reservoir shoreline miles within 3-mile radius of nest: _____

B. Habitat

1. Habitat Type: _____

2. Timber/cover Type: _____

3. PI Type: _____

4. Canopy Closure: _____

5. Size of nest stand: _____

6. Habitat composition within 3-mile radius of nest:

- | | |
|----------------------|---|
| a. open water _____% | g. deciduous _____% |
| b. urban _____% | h. open conifer _____%
(< 70% closure) |
| c. cropland _____% | i. dense conifer _____%
(> 70% closure) |
| d. riparian _____% | j. other _____% |
| e. grassland _____% | |
| f. shrubland _____% | |

7. Number of habitat turnovers intersected along four, three mile transect lines extending from nest:

- | | |
|----------------|---------------|
| a. north _____ | c. east _____ |
| b. south _____ | d. west _____ |

8. Direction and distance from nest to nearest edge (identify contrasting habitat): _____

C. Potential Disturbances

1. Distance to transportation route:

	<u>Below Nest</u> <u>Elevation</u>	<u>Even</u> <u>With</u>	<u>Above Nest</u> <u>Elevation</u>
a. major highway	_____	_____	_____
b. primary road	_____	_____	_____
c. secondary road	_____	_____	_____
d. primitive road	_____	_____	_____
e. railroad	_____	_____	_____
f. trail	_____	_____	_____
g. high voltage power line	_____	_____	_____

2. Road density within:

	<u>Major Highway</u>	<u>Primary Road</u>	<u>Secondary Road</u>	<u>Primitive Road</u>
a. 1 mile radius of nest:	_____	_____	_____	_____
b. 3 mile radius of nest:	_____	_____	_____	_____

3. Distance to human development:

	<u>Below Nest Elevation</u>	<u>Even With</u>	<u>Above Nest Elevation</u>
a. residence	_____	_____	_____
b. recreation site	_____	_____	_____
c. other	_____	_____	_____

4. Number of residences within:

a. 1 mile radius of nest: _____

b. 3 mile radius of nest: _____

5. Percent of AWB shoreline that is developed:

a. 1 mile of shoreline either side of a nearest distance line from nest to shoreline: _____

b. as above except 3 miles of shoreline: _____

6. Amount and season of recreation use of associated water body:

1 2 3 4 5 6 7 8 9 10 11 12

Does power boating/water skiing occur? yes no

7. Timber harvest activities:

a. nest site cutover: yes no
if yes, what type of cut: _____

b. within nest stand (but not nest site): yes no
if yes, type of cut and distance: _____
if yes, percent of nest stand cutover: _____

c. within 1/4 mile: yes no
if yes, percent of area cut over by type of cut: _____

d. 1/4 to 1/2 mile: yes no
if yes, percent of area cut over by type of cut: _____

D. Land Status

1. Land Ownership: _____
2. If non-FS land:
 - a. Is it within Forest boundary: yes no
 - b. Distance to FS land: _____
3. If FS land:
 - a. Within Special Management Area: yes no
If yes, which one: _____
- _____
- _____
- If no, Forest Allocation: _____
- _____
4. If FS land:
 - a. Compartment and stand number: _____
 - b. Stand exam data available: yes no
 - c. Territory Management Plan complete: yes no
5. Percent of area in private land:
 - a. 1 mile radius of nest: _____
 - b. 3 mile radius of nest: _____
6. Is aquatic/fish data available for AWB: yes no

E. Territory

1. Distance to nearest occupied bald eagle territory:
 - a. Straight line: _____
 - b. Shoreline: _____
2. Alternate nest(s) present in territory: yes no
If yes, direction, distance, and position on slope from this nest: _____
3. Documented nest turnover in territory: yes no
If yes, direction, distance, and position on slope from this nest: _____
4. Any other raptor or heron nests within 3 mile radius: yes no
unknown
If yes, distance by species: _____
5. Comments: _____

APPENDIX II

List of Variables

	NOT INCLUDED IN ANALYSIS
A. General	
1. Territory name	X
2. Territory number	X
3. Province	X
4. Subsection	X
5. Land type	X
6. Hydrologic unit	X
7. Average Annual Snowfall*	
8. Nest Tree Species*	
B. Physical/Topography	
1. Elevation	
2. Aspect	
3. Slope	
4. Position on slope	
5. Type of associated water body	
6. Size of associated water body	
7. Direction to associated water body	
8. Distance to associated water body	
9. Elevation above associated water body	
10. Line-of-sight to associated water body	
11. Direction to nearest greater than fourth order stream	
12. Distance to nearest greater than fourth order stream	
13. Greater than fourth order stream miles (3-mile radius)	
14. Direction to nearest lake, etc.	
15. Distance to nearest lake, etc.	
16. Shoreline miles (3-mile radius)	
17. Distance to stillwater inlet or outlet*	
18. Distance to major tributary*	
C. Habitat Composition	
1. Habitat type	X
2. Cover type	X
3. PI type	X
4. Canopy closure	
5. Stand size	
6. Percent composition in a 3-mile radius	
- open water	
- urban	
- cropland	
- riparian	
- grassland	
- shrubland	
- open conifer	
- closed conifer	
- other	
7. Number habitat turnovers along a 3-mile transect line	
- north	
- south	
- east	
- west	
8. Direction to nearest habitat turnover	
9. Distance to nearest habitat turnover	

NOT INCLUDED IN
ANALYSIS

D. Disturbance variables

1. Distance to transportation routes
(below, even, and above nest elevation)
 - major highway
 - primary road
 - secondary road
 - primitive road
 - trail
 - railroad
2. Distance to other human disturbances
(above, even, and below nest elevation)
 - power line
 - residence
 - recreation site
 - other
3. Miles of transportation routes
(within one and three mile radius)
 - major highway
 - primary road
 - secondary road
 - primitive road
4. Number of human residences
(within one and three mile radius)
5. Percent of shoreline development of AWB
(within one and three mile radius)
6. Recreation use of AWB
 - amount by month
 - power boats
7. Cutover nest-site
 - type of harvest
8. Cutover nest stand
 - type of harvest
 - percent affected area
9. Cuts within 1/4 mile
 - type of harvest
 - percent affected area
10. Cuts within 1/2 mile
 - type of harvest
 - percent affected area

X

E. Land Status

1. Land ownership
2. Distance to Forest Service land
3. Within special management area?
4. Percent of territory in private land
(within a one and three mile radius)
5. Stand data availability
6. Aquatic data availability

X

X

X

X

	NOT INCLUDED IN ANALYSIS
F. Territory Interspersion	
1. Distance to nearest occupied bald eagle territory.	
- straight line	X
- shoreline	X
2. Alternate nests	X
3. Documented nest turnover	X
4. Other raptor nests within 3-miles	X
5. Comments	X

* variable added to the analysis, not part of original nest site description form.

APPENDIX III

List of Nest-Sites

I. Upper Columbia Zone (007)

- A. Blackfoot River
 - 1. Red Rock 007-001-01
 - 2. Clearwater 007-002-01
 - 3. Sperry Grade 007-003-01
 - 4. Blackfoot Junction 007-004-01
 - 5. -02
 - 6. Helmville Junction 007-005-01
 - 7. Nevada Creek 007-006-01
 - 8. Nevada Reservoir 007-028-01
- B. Bitterroot River
 - 9. Schroader 007-007-01
- C. Swan River
 - 10. Swan Refuge 007-009-01
- D. Upper Flathead River
 - 11. Clayton Island 007-010-01
 - 12. Cyclone Lake 007-011-01
 - 13. McDonald Lake 007-012-01
 - 14. Logging Lake 007-013-01
 - 15. Fennon Slough 007-014-01
 - 16. Foy's Bend 007-031-01
- F. Flathead Lake
 - 17. North Shore 007-015-03
- F. Kalispell Lakes
 - 18. Mary Ronan 007-018-01
 - 19. Bitterroot Lake 007-019-01
 - 20. Stillwater Lake 007-020-01
 - 21. Swift Creek 007-021-01
 - 22. Ashley Lake 007-023-01
 - 23. Lower Stillwater 007-030-01
- G. Kootenai River
 - 24. Young's Creek 007-022-02
 - 25. Bull Lake 007-024-01
 - 26. -02
 - 27. Rereg 007-025-01
 - 28. Dunn Creek 007-029-01

II. Greater Yellowstone Ecosystem (018)

- A. All sites
 - 1. Culver Springs 018-001-01
 - 2. Horse Butte 018-002-01
 - 3. Whits Ridge 018-003-01
 - 4. Cliff Lake 018-004-01
 - 5. -02
 - 6. Wade Lake 018-005-01
 - 7. Elk Lake 018-008-01
 - 8. Beaver Creek 018-006-01
 - 9. Wall Canyon 018-007-01